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RAILROAD GAZETTE

A JOURNAL OF TRANSPORTATION, ENGINEERING AND RAILROAD NEWS

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FORTY-FOURTH YEAR

NEW YORK - - 32 PARK PLACE

1900

RAILROAD GAZETTE

FRIDAY, JANUARY 5, 1900.

CONTENTS.

ILLUSTRATIONS:	PAGE
The 600-ton Coaling Station of the Lehigh Valley Railroad	2
American Practice in Block Signaling. Part I.	4
An Old Chain Bridge	5
Chicago & Alton Eight-Wheel Passenger Locomotive	8
CONTRIBUTIONS:	
The Output of the Brooks Locomotive Works	1
Ten-Wheel Express Locomotives of the North Eastern Railway	1
The Theory of Velocity Grades	1
EDITORIALS:	
The Signal Engineer	6
The Advanced Trunk Line Freight Rates	6
EDITORIAL NOTES	6, 7
New Publications	7
GENERAL NEWS:	
Locomotive Building	11
Car Building	11
Bridge Building	12
Meetings and Announcements	12
Personal	12
Elections and Appointments	13
Railroad Construction	14
General Railroad News	14
MISCELLANEOUS:	
Technical	10
The Scrap Heap	11
The Official Classification and the Anti-Trust Law.	1
Railroad Presidents on the Outlook	1
The Work of the Bureau of Yards and Docks	3
Mississippi Railroad Commissioners' Report	3
Chicago Track Elevation	3
Life of Steel-Wire Cables	5
Railroad Charters	9

Contributions.

The Output of the Brooks Locomotive Works.

Dunkirk, N. Y., Dec. 29, 1899.

To the Editor of the Railroad Gazette:

In summarizing our output for 1899 and comparing it with that of former years, we find it presents some interesting features, particularly as showing the marked tendency on the part of railroad companies for heavier locomotives. This is demonstrated by a comparison with our output for 1891, our best previous year as regards number of engines completed.

Brooks Locomotive Works Output for Years 1891 and 1899.

	1891.	1899.	
Engines completed	226	300	
Weight engines and tenders in working order, lbs.	41,726,350	81,123,600	Increase 94½%.
Ditto, short tons	20,863	40,562	Increase about 20,000.
Average weight, lbs.	184,629	270,412	Av. increase 85,783 lbs.
Weight of engines only—in working order—lbs.	25,455,100	49,730,400	Increase 95½%.
Ditto, short tons	12,728	24,865	Increase about 12,000.
Average weight, lbs.	112,633	165,768	Av. increase 53,135 lbs.
Total weight engines and tenders empty, showing actual weight material produced, lbs.	29,778,410	57,681,300	Increase 93¾%.
Ditto, short tons	14,889	28,841	Increase about 14,000.

Basing the output of engines and tenders in working order for 1899 at the average weight produced in 1891 would equal 439 complete locomotives.

The lightest locomotive built during the year was a mogul engine and tender weighing, in working order, 97,014 lbs., the heaviest a 12-wheeled engine and tender weighing, in working order, 364,900 lbs. The latter has 23 in. x 30 in. cylinders and is the largest locomotive in the world.

BROOKS LOCOMOTIVE WORKS.

Ten-Wheel Express Locomotive for the North Eastern Railway.

Edinburgh, Scotland, Nov. 25, 1899.

To the Editor of the Railroad Gazette:

In your issue of Nov. 10th (p. 773), in describing this locomotive, the following is printed: ". . . the trains run 124.5 miles at 53 miles an hour without stopping. The weight of these trains behind the tender varies from 390 to 420 net tons, and gradients of 1 in 96 for about 5 miles, and others of 1 in 150, 1 in 170, and 1 in 200 are met on different parts of the line."

Some large errors have crept in here. There are no such things in Great Britain as express trains weighing nearly 390 tons of cars; an express of 300 tons is looked upon as very heavy. As a matter of fact, these North Eastern trains which run from Newcastle to Edinburgh without a stop weigh from 255 to 270 tons behind the tender.

As to speed—two trains run this 124.5 miles in 143 minutes, or 52.2 miles an hour, and the short gradient of 1 in 96 is in favor of the locomotive; one train runs from Edinburgh to Newcastle in 149 minutes, or only 50.1 miles an hour, going up the 1 in 96.

These new engines do good work, but certainly the boiler is too small and the cylinders too large in proportion.

NORMAN D. MACDONALD.

[The original documents from which our description was made up have been destroyed, and we cannot now find the origin of the error. It seems probable that we took the load that the engines are designed to haul as the load which they do haul.—Editor.]

The Theory of Velocity Grades.

Roanoke, Va., Dec. 26, 1899.

To the Editor of the Railroad Gazette:

The following in reply to "Kicker" and Mr. Raymond in the matter of velocity grades:

Formula VII. of Nov. 30 is correctly generalized by Mr. Raymond as

$$L = \frac{4}{3}\,\frac{(S_1 + 10)(S_1' + S_2)}{R + 20\,G},$$

the considerations used by the writer as leading up to Formula VII. being as follows:

A velocity grade is one on which the momentum of the train is utilized; the effect being to reduce the speed from S_1 (initial) to S_2 (final).

Formula III. gives the least weight of train that can pull down the speed eventually to the final assumed rate, S_2, on the given grade, G. A greater weight of train than this will reduce the length of the velocity grade. A less weight of train will not pull the speed down to S_2.

The weight of train given by Formula III. is therefore the one that fixes the length of the maximum velocity grade. Formula IV. gives, when transposed, the length of velocity grade for a given weight of train. The combination of the two, Formula VII, expressed generally, is therefore the equation sought.

With regard to the reasonableness of the expression

$$P = \frac{4\,D}{S + 10},$$

as fairly representing traction: as "Kicker" has mentioned Wellington's Railway Location, the writer would refer him to page 532 (edition of 1887) where it is stated as a result of experiment that between speeds of 17 and 23 miles an hour the traction was found to be "nearly ¼" of the weight on driving wheels. Also to page 519, where the traction at starting, say 6 miles an hour, and at 50 miles an hour, are found to agree closely with the formula.

At 20 miles an hour an engine of 150,000 lbs. on drivers would have to indicate by cylinder diagrams appreciably in excess of 1,067 horse power, in order to agree with the formula. This is the effective output of power, delivered at the rails, by the formula at that speed. That this is usually or continuously exceeded by most engines of such weight is not apparent to the writer.

Further, it is best, in his opinion, not to use too high an expression for traction in planning velocity grades. Then, if a car can be added to the train when the work is done, it is far better than to have to sidetrack one, as absolute accuracy is out of the question.

Also, the method of determining the average traction by adding the tractions at the extremes of speed and dividing by two, gives an average traction which is in excess of the actual average. This was assumed to offset the effect of the rotative energy of the car wheels and both facts were disregarded in the general expression in consequence. Both errors if they may be so called, become zero at the same point; namely, at a uniform speed.

The effect of the use of the formula would not be to reduce the weight of trains, "Kicker" imagines, but it would result in an appreciation of what actually occurs; namely, that at hard pulls the speed is decreased until the traction increases sufficiently to meet the necessities of the case.

The negative value of L, mentioned Nov. 30, resulted from combining $S_1 = 25$ and $S_2 = 5$ with $S = 11$; which, as before mentioned, is of no practical utility.

CHAS. C. WENTWORTH.

The Official Classification and the Anti-Trust Law.

Attorney General Griggs has declined to institute proceedings for an injunction against the putting into effect of the proposed changes in the official classification which have been adopted by the Trunk Lines and their western connections.

The claim put forth by the representatives of the commercial bodies on whose application the hearing before the Interstate Commerce Commission was had was that the evidence presented disclosed a combination on the part of the railroads in restraint of trade and consequently a violation of the Anti-trust law. The Attorney General says that to secure an injunction under the Anti-trust law it must be shown that there is a "contract, combination or conspiracy in restraint of trade or commerce among the several states." No such combination has been shown. The testimony shows that all action taken by the railroad companies in adopting the classification, or changes thereto, is taken independently after a consultation among the members of the committee; no compulsion is shown, nor is it shown that the operation of the classification is in restraint of interstate commerce, which is also necessary to be shown in order to constitute a violation of the Anti-trust law. On this point he says:

"There must not only be a contract, combination or conspiracy, but it must be in restraint of interstate commerce. As applied to carriers, this means a combination to suppress competition. The filing of an official classification does not fix the rates. It places articles in certain classes, but the rates for the classes are determined by the railroad companies outside of the classification. If a railroad maintains the existing rates, the change of an article from a lower to a higher class will increase the rate, but from aught that appears in this testimony every railroad company using the classification is at liberty at any time to change the existing rates upon giving the notice required by the Interstate Commerce act. Moreover, each railroad company is free to take any article out of the existing classification by making a commodity rate. In other words, no suppression of competition, no arbitrary fixing of rates, no restraint of interstate commerce is shown."

Referring to the Trans-Missouri and Joint Traffic Association cases, he says that these cases afford no precedent for the action asked for in the present case. Each of these associations was formed under a contract which was held to absolutely destroy the power of independent action in fixing rates. As distinguishing between cause for action under the Interstate Commerce law and the Anti-trust law, he said:

"A railroad company may raise its rates to an unreasonable point, it may discriminate among its shippers, it may charge more for a short than a long haul, but none of these acts, however unjust and wrongful, amounts to a violation of the Anti-trust law."

The Attorney General said, further: "If the testimony submitted showed a combination among the railroads to restrain commerce among the several states I would not hesitate to invoke the remedy provided by the Anti-trust law, but to take such action upon the faith of the facts submitted would not only be futile, but absurd. If there be a remedy for the complaining shippers it lies in an appeal to the commission under the Interstate Commerce law."

Railroad Presidents on the Outlook.

Leonard's Railway News (New York City) publishes interviews with Presidents S. R. Callaway, E. B. Thomas, Henry Fink, M. E. Ingalls, W. H. Truesdale, O. D. Ashley, Alfred Walter and Thomas P. Fowler on the business of the year just closed and the prospects for 1900. All expect the heavy traffic now enjoyed by the railroads to last at least a year, and there is considerable expression of confidence for a still longer period. All, of course, have the same story to tell about unparalleled gross earnings during 1899, and all say that the large increase in the cost of materials has not yet greatly affected the expense accounts, for the reason that the materials thus far paid for were ordered many months ago.

Mr. Callaway, of the New York Central, says that for the first 23 days of December the passenger earnings of the Central increased $202,000 over the same period of last year. Whether or not this is on the same mileage in both years is not stated. The Central has spent 15 millions for new equipment during the past year and therefore does not expect to make any expenditures in that direction this year.

Mr. Thomas (Erie) emphasized the fact that local traffic is now having a marked expansion as compared with through traffic. The Erie has enjoyed a very satisfactory increase in passenger traffic and this increase is greater in local than in through.

Mr. Fink spoke chiefly of his own road, the Norfolk & Western, which, during the past 12 months, has increased its gross earnings 12 per cent. and net about 26 per cent. He emphasized the fact, alluded to also by other Presidents, that the worst cloud hanging over the railroad world is the constant danger of unjust and unwise legislation by Congress and by the states.

Mr. Ingalls (C., C., C. & St. L. and C. & O.) has spent about five millions for new equipment during the past year, charging one-fifth of this sum to operating expenses. The greatest advantage coming to the railroads from the increased prosperity of the country will be in local business rather than in through; for this reason the advances in freight rates, which have just been adopted, are of less importance than is sometimes made to appear. Concerning the maintenance of rates Mr. Ingalls thinks the situation to-day is ideal. All the Trunk Lines will be taxed to take care of their local business, and it looks as though the through low-price freight would go begging.

Mr. Truesdale (D., L. & W.) considers the prospects for maintenance of rates "fairly good," which would seem to indicate that his hopes for the future are somewhat less enthusiastic than those of some other people.

Mr. Ashley (Wabash) expects the present good traffic to continue, and he notes the increase in freight rates, but as expenses are increasing he will be satisfied if his net earnings this year are as good as those of last.

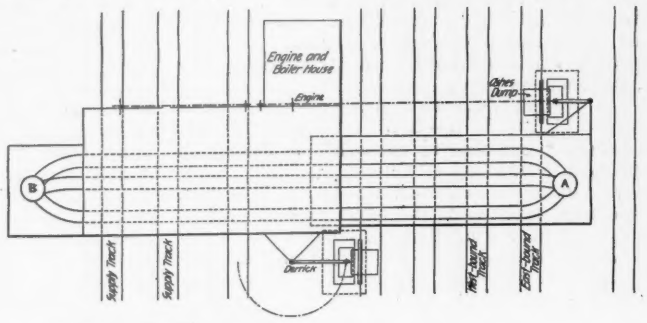
Mr. Walter (L. V.) has ordered 75 engines and 5,000 cars, two-thirds of which are yet to be delivered. He does not expect to make further purchases in this direction this year. Mr. Fowler (N. Y., O. & W.) spent $200,000 for new equipment in 1899 and expects to spend $250,000 this year.

The 600-Ton Coaling Station of the Lehigh Valley Railroad.

The Link Belt Engineering Co. has just completed on the main line of the Lehigh Valley Railroad at South Plainfield, N. J., a coaling station having a storage capacity of 600 tons. It has many features in common with the Erie coaling station at Jersey City, which was also built by this company and described in the Railroad Gazette April 14, 1899.

In designing the South Plainfield plant, it was not possible to put the storage pocket lengthwise of the track, and coal the locomotives directly from it, as in the Jersey City plant. The method as used at the Erie Railroad station may be cheaper, but will do only at station yards. Nearly all the engines on through trains (both passenger and freight) will be coaled at South Plainfield, thus making it necessary to put the storage pocket at right angles to the track, as shown. The tracks on the coaling bridge are in straight lines directly under the pocket; thus coal from every bin can be carried to the bridge, and besides this advantage curves in the track for the loaded cars are avoided. The hoppers on the bridge carry sufficient coal to avoid delays which might arise from the shifting and dumping of the cars. The chutes used in connection with the bridge hoppers are counterweighted, so that when the engine is through coaling the movable part of the chute automatically folds up out of the way of passing trains.

Fig. 1 shows a view of the coaling station looking west. The arrangement of the coal handling machinery and the general plan of the building are shown in Fig. 2. The carrier here illustrated is made up of a line of continuous overlapping buckets, rigidly secured to two strands of chain by



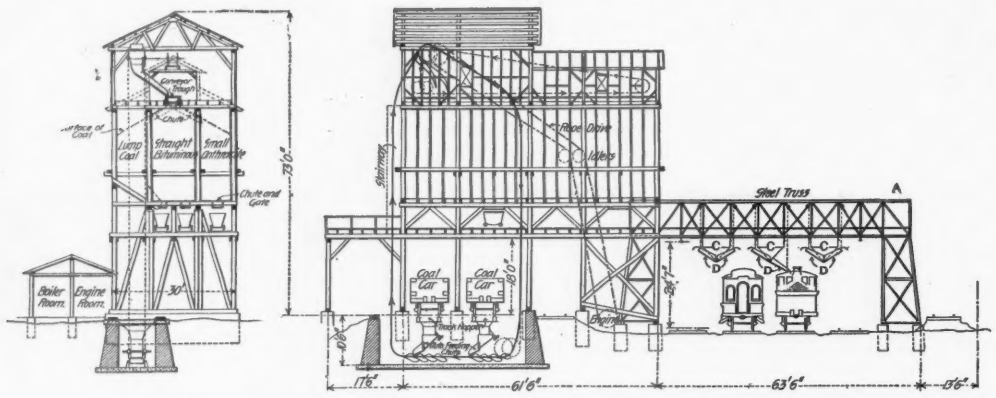


Fig. 2.—General Layout of Building and Machinery—Lehigh Valley Coaling Plant.

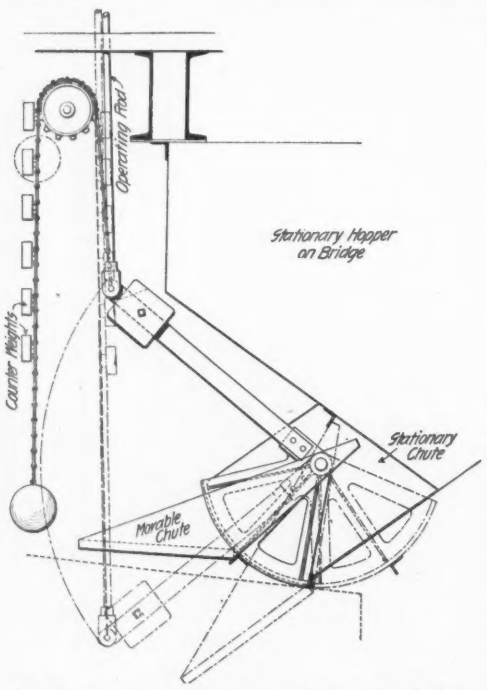


Fig 10.—Counterweighted Gate and Chute Attached to Bridge Hoppers

which the coal is carried along the horizontal run and up the vertical leg without spilling. Above the horizontal run and at the left end of the building, Fig. 2, at a point where the coal cars are shown, are two track hoppers into which the coal to be stored is dumped. Each of these is fitted with an automatic feeding chute, shown more clearly in Fig. 3. These chutes have a pair of small wheels which travel on the sides of the overlapping buckets, as shown in Fig. 4. As the line of buckets moves forward, the wheels follow the contour of the sides of the buckets, and the lip of the chute is alternately raised and lowered. The amount of this raising and lowering (which is regulated by a hand wheel) fixes the quantity of coal put in each bucket. A detail of the mechanism used in raising and lowering these chutes is shown in Fig. 5. The heavy dotted lines show the bottom of the chute to which the plates A are bolted. These plates are made with slides, into which the journal boxes of the shaft B are fitted. These are connected with a worm to the miter gears, which in turn are worked by the hand wheels. To alter the pitch of the chute the hand wheel H is revolved, which results in turning the small wheels in or out from the shaft D. The pitch of the stationary part of these chutes can also be changed by means of the hand wheel E, Fig. 3.

The loaded buckets, on reaching the head wheels of the carrier, are inverted and discharge their contents into a chute leading to a conveyor which runs horizontally through the lantern of the storage pocket. This is a double-strand, suspended-flight conveyor, and by it the coal is deposited in any of the six bins which make up the pocket. The coal is delivered through 12 gates, which are at the bottom of the steel conveyor trough. These gates are worked by hand wheels and double chutes are fitted under the gates, either side of which can be opened or closed, thus allowing coal to be fed into any one of the bins as desired.

The machinery is driven by equalizing gears, which in turn are driven by manila ropes. The 35-h. p. steam engine, which drives the machinery, is in a small frame building at the side of the coaling station, as shown in Fig. 1. Coal is fed from the pocket to the boiler room through an iron pipe passing through the roof of the engine house, as shown in Fig. 1.

The storage pocket is divided into six bins by one partition through the entire length, and three cross partitions. Each bins has three chutes, making 18 in all. The machinery readily stores 80 tons of coal an hour, and it is the practice to use one of the track hoppers exclusively for bituminous and the other for anthracite. This renders it unnecessary to change the angles of the automatic chute. When the proper inclinations have been found, they are retained until a change of conditions makes it necessary to alter the slant. The lump anthracite is deposited in certain bins of the pocket, the bituminous in others; and when it is desired to store the mixture of bird's-eye or of rice and bituminous, the two automatic feeding chutes are run simultaneously. The wheels on their hinged ends are adjusted so that one chute will deliver to each one of the line of buckets a certain amount of bituminous while the other will place with it the desired percentage of small anthracite. The two kinds of coal become thoroughly mixed as they are transferred from the carrier to the overhead conveyor, and from the conveyor to the mixture bins. This mixing of the anthracite with bituminous is therefore done without any extra cost.

Fig. 1.—The Lehigh Valley Railroad Coaling Station t South Plainfield, N. J.

What is known as an "under-cut" gate has been adopted for use in connection with the chutes, through which the coal flows from the storage bins to the coaling cars and from the bridge hoppers to the tenders. Its method of working is as follows: The operator, by means of a lever, opens the gate which moves in are arc of a circle and in closing cuts up through the stream of coal. Even a very large lump cannot prevent it from instantly closing. It is also amply counterweighted, which helps it to work freely.

The conveyors are oiled by an ingenious device. The two strands of chain to which the buckets are attached are connected by shafts which serve as journals for the small rollers which carry the buckets. In the hubs of these rollers are inserted curved tubes, as shown in Fig. 6. Adjacent and parallel to the track on which the rollers run is placed a long oil pan about 8 in. wide, which is attached to the upper bar of a simple device which works like a parallel-ruler. As the buckets move along the oil

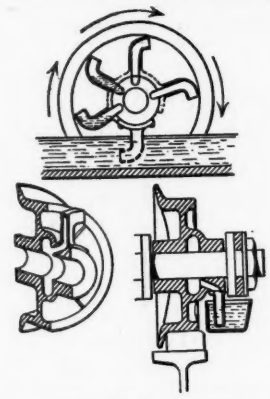


Fig. 6.—Oiling Device for Conveyors.

pan, the fingers scoop up from it sufficient oil to lubricate the axles of the rollers and the joints of the chain. The line of buckets is about 216 ft. long and travels at 60 ft. a minute, so that the oiling is done in less than four minutes, after which the oil pan is shifted out of the reach of the fingers by means of a lever worked by hand.

The method of coaling a locomotive is as follows: The bridge shown in Figs. 1 and 2 extends over the four main-line tracks. There are three tracks on the bridge, each leading to a turn-table, shown at A, Fig. 2. These tracks extend through the building, passing directly under the coal chutes from the bins, as shown in the end elevation, and end at a turntable at B. Twelve cars, similar to the one shown in Figs. 7 and 8, are used. These cars have a capacity of two tons each and are run under the coal bins, each of which are fitted with an under-cut

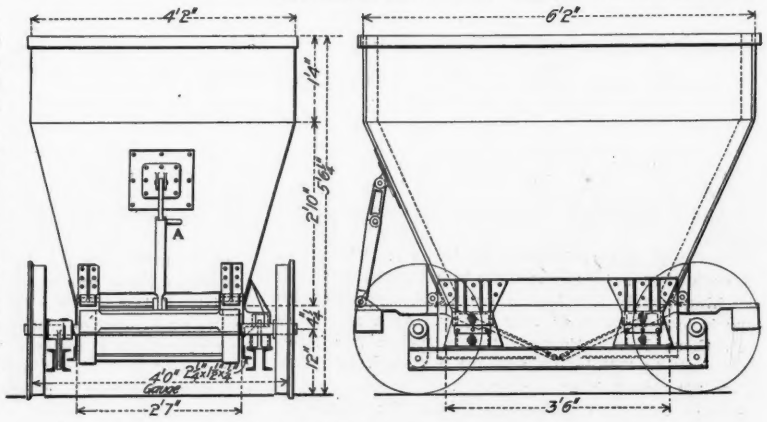


Fig. 7.—Details of Two-ton Coal Car.

gate. The gate is opened, allowing the coal to drop into the cars, after which the car is pushed out on the bridge by a man until it is over the desired stationary hopper. A slight movement given to the handle A of the car releases the toggle joint, thus allowing the doors to drop. The doors are counterweighted as shown and require but little effort to close them. Three of these hoppers are fixed on the bridge, as shown at C, Fig. 2, and each of which

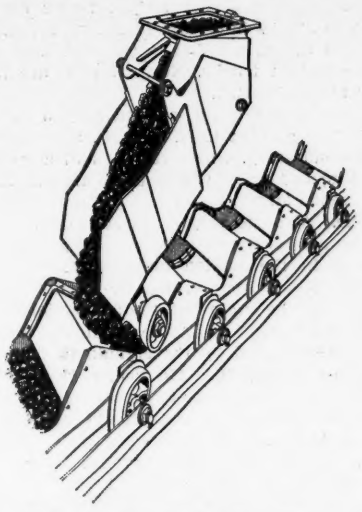


Fig 4.—Automatic Feeding Chute.

holds about 15 tons. The stationary hoppers receive coal from any one of the three tracks on the bridge. An engraving of one of these hoppers is shown in Fig. 9. A movable chute working in conjunction with an under-cut gate is attached to the stationary chute of the hopper, as shown at D, Fig. 2. This chute and gate allow the coal to drop into the tender. The device used for opening these gates is shown in Fig. 10 and its movements are regulated from the bridge. None of the work required in loading the tender is done by the engineman. The three stationary hoppers attached to the bridge are always kept filled with coal, so that there need be no unnecessary delay to the engine while coaling. These stationary hoppers just referred to, are not shown in Fig. 1, as this photograph was taken before the hoppers were attached to the truss.

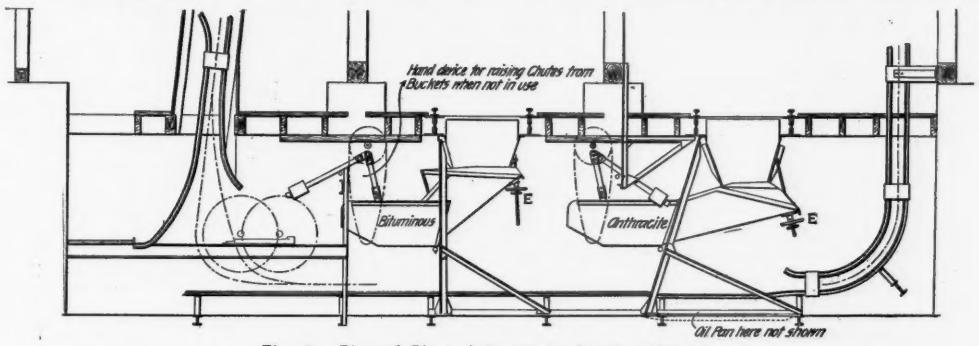


Fig. 3.—Plan of Pit and Automatic Feeding Chutes.

The Work of the Bureau of Yards and Docks.

The annual report of Admiral Endicott, Chief of the Bureau of Yards and Docks, U. S. N., for the fiscal year ending 1899, is received. The expenditures during that year amounted to $2,815,000. Contracts have been entered into within the year ending June 30, 1899, involving the expenditure of $3,447,000.

We have already described the work to be done at Algiers, La., in the way of building a floating dry dock. The contract for this was let to the Maryland Steel Company for $810,000. The dock will be built at Sparrow's Point and towed to its destination.

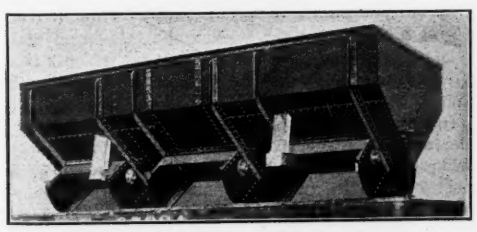


Fig. 9.—Stationary Bridge Hopper.

The Department has let contracts for dry docks to be built at Portsmouth, N. H., and at Boston, both of masonry. O'Brien & Sheehan, of New York, took the contract for the Boston dry dock and caisson for $883,400, and Farrell & Hopper, of New York, took the contract for the machinery for $130,000. It is believed that the contract will be finished within the time limit of 2½ years. The contract for the Portsmouth dock was let to John Pierce, of New York, for $1,089,000. The dry dock for the Mare Island Navy Yard, which is to be of timber, was let to the Atlantic, Gulf & Pacific Co., of New York, for $729,000. All of these structures are to be 750 ft. long, 80 ft. wide on the floor and 30 ft. draught at mean high water. Drawings and detailed descriptions of all of these docks are given in the report.

The estimates for improvements for the fiscal year 1900 and 1901 amount to 14¾ million dollars. The war revealed the inadequacy of the equipment of all of our yards and business was carried on at great disadvantage. The Chief of the Bureau says "the public works should be equal to putting the entire navy, including the portion in reserve, into immediate service and keeping it there continuously." For this all the yards and stations require expansion. The improvements to be carried out at the various yards and stations are described in considerable detail in the report. The reader will be astonished to find, for instance, that at the Portsmouth Navy Yard there is no railroad system, and all stores and materials have to be transported by teams. An appropriation for laying down a railroad with rolling stock of standard gage is recommended.

An appropriation has already been made for a railroad at the Boston yard. The machine tools there are described as old, antiquated in pattern and much deteriorated by the wear and tear of the great number of years of their service. The modest appropriation of $5,000 is asked to put in a few modern tools.

The estimate for the New York yard amounts to $2,157,000. There are three items of $300,000 each, namely, progress work on the stone and concrete dock, completing repairs to dock No. 2 and barracks for enlisted men. The public works important to be provided for in the next year in the League Island Navy Yard amounts to $2,218,000, the heaviest item here being also $300,000 for barracks. It is recommended that $1,649,000 be spent at the Norfolk Navy Yard. Of this $300,000 is to begin the work on the concrete and stone dry dock, $300,000 for barracks and $500,000 for the purchase of land.

The principal item at the Port Royal naval station is $500,000 for rebuilding the dry dock. This was completed and accepted by the Government in 1895. From a time before this completion up to the present it has suffered from a series of accidents. It is built of timber and the Bureau is of the opinion that it should be rebuilt in concrete and stone. This is necessary if the dock is to be reliable, and it will be economy if it is to be maintained for the use of the Navy.

The Chief of Bureau devotes 12 pages to the subject of dry docks in general. In this he reviews the recent legislation and summarizes the recent discussions on the subject of masonry versus timber docks. The reader of course, knows Admiral Endicott's opinion, with which every reasonable and unprejudiced man must agree, namely, that speaking broadly, it is a foolish policy to build wooden docks.

Mississippi Railroad Commissioners' Report.

The Railroad Commissioners of Mississippi have completed the seventh biennial report of the Board. From an account published in the Memphis Appeal we take the following paragraphs:

In this State there are two railroads that are vital to the development of the business interests of the commonwealth, the Illinois Central and the Mobile & Ohio. Whoever will read Mr. Fish's paper submitted to the industrial commission must be satisfied that no man has ever had a clearer conception of the value of the Southern route; and that he is honest in purpose and determined to develop the country through which his road runs.

As to the Mobile & Ohio, under Mr. Russell's administration, the rapid increase in the earning power of the property has been phenomenal, and yet his management has been liberal beyond precedent. With these two men there should be no trouble in arranging a working basis between the commission and the railroads. Still the fact remains that the present adjustment of rates is not fair to the State. If the railroad managers fail to recognize these rights there is a remedy which must be used, however unwilling the commission may be to invoke it. This is the power to tax. To-day taxation upon the railroad properties in this State is far less than in any other, and still it is high enough, provided the railroads make reasonable rates. Sensible reduction in rates benefits the railroads as well as the people; increase in taxation increases fixed charges of the railroads, thereby lessening their net earnings and injuring property whose successful management and prosperity is of great importance to the Commonwealth. To sum up: First, there can be little doubt of the fair adjustment of rates between honest railroad

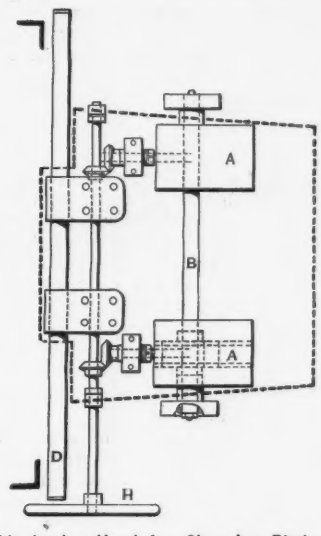


Fig. 5.—Mechanism Used for Changing Pitch of Chutes.

managers and an intelligent railroad commission. Second, it is the duty of the railroad commission to use their efforts to this end. Third, failing in this, it is the duty of the railroad commission to see that whatever money is taken from the people through unjust rates should be recovered through taxation.

. . . Reductions made three years ago on the Illinois Central through the agency of this commission have amounted to more than $300,000 per annum. An examination of the changes made in local rates in addition to this will show another saving of at lease $300,000.

. . . The total mileage of road in the State is 2,675. The increase in two years is 102 miles.

The total valuation of all railroad property in the State for 1899 is $25,731,165. The valuation of palace car companies is $94,400. Express companies are valued at $16,048, telegraph companies at $296,963. Total State tax on all these, $171,200.

Chicago Track Elevation.

The annual report of the Engineer of Track Elevation, Chicago, gives the status of that work at the end of the year 1899. In all 16.3 miles of roadbed were raised and 99 grade crossings were eliminated, the approximate cost being about $4,305,000. The roads concerned in this work were the Chicago, Milwaukee & St. Paul; Chicago & Northwestern; Chicago, Rock Island & Pacific, and Atchison, Topeka & Santa Fe.

During the year two track elevation ordinances were passed and approved by the railroads, one for the elevation of the Pittsburgh, Ft. Wayne & Chicago, Chicago & Western Indiana and adjacent roads, which provided for the raising of 12.4 miles of road-

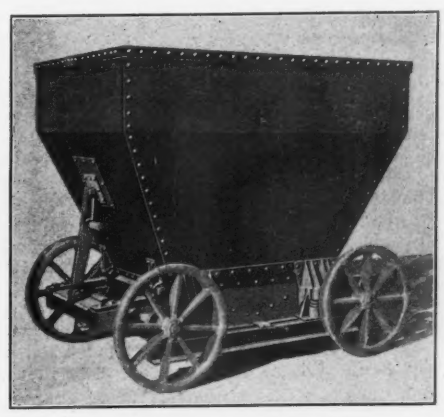


Fig. 8.—Two-Ton Coal Car.

bed, 141.6 miles of single track, the construction of 57 subways and the elimination of 78 grade crossings; the estimated cost of the work is $3,400,000. The other ordinance is for the elevation of the Atchison, Topeka & Santa Fe; Chicago, Madison & Northern; Chicago & Alton; Pittsburgh, Cincinnati, Chicago & St. Louis and adjacent lines. This ordinance covers 13.3 miles of roadbed and 47 miles of single track, avoids 51 grade crossings, and $2,658,000 is estimated

as the cost of the work called for. The following table gives the status of track elevation Dec. 31, 1899:

Total miles to be elevated	450.45
Total miles track elevated Dec. 31, 1899	262.12
Total miles yet to be elevated	188.33
Total number grade crossings eliminated by ordinance	417
Total number grade crossings eliminated Dec. 31, 1899	283
Total grade crossings to be eliminated	134
Total number subways constructed under ordinance	373
Total number subways constructed to Dec. 31, 1899	274
Total number subways to be constructed	99
Total cost elevation as per ordinances passed	$23,063,000
Total cost of elevation to Dec. 31, 1899	17,005,000
Total estimated cost of further elevation	$6,058,000

American Practice in Block Signaling.*

By B. B. ADAMS.

I.

This is the title of a book published by the Railroad Gazette, which was first issued in 1891. This book describes the methods in use for maintaining an interval of space between railroad trains, as worked by the prominent companies at that time, and contains descriptions and drawings of the electrical and other apparatus used in those systems which employ means other than the simple telegraph and manual signals. As the use of the block system has been greatly extended since 1891, and as many modifications and improvements have been made in electrical and other machinery used in block signaling, it is purposed to give in this and succeeding numbers of the Railroad Gazette a series of articles, well illustrated, embracing a thorough revision of the matter printed eight years ago. Now, as in the earlier work, the aim will be to treat the subject from the most practical standpoint, with only incidental reference to the history of this branch of the railroad art. Well approved practice, rather than ideals, however desirable, or experiments, however hopeful, will form the substance of the work.

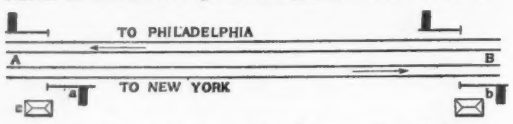


Fig. 1.—Typical Block Section Between New York and Philadelphia.

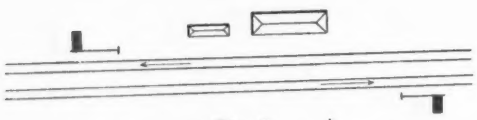


Fig. 6.

THE TELEGRAPH BLOCK SYSTEM.

The simplest method of maintaining the space interval has been designated by the American Railway Association the "Telegraph Block System." The first use of this in America, at least on any extended scale, was on what is now the Pennsylvania railroad, between New York and Philadelphia, and the rules and practice of that road will be first described.

The railroad (double track) is divided into block sections, each section, for brevity, being called a block. These sections vary in length from less than a mile, where trains must be very frequent, to three miles or even longer, where a longer interval of time between trains will not cause inconvenient delays. The main line of the Philadelphia division of the Pennsylvania from Philadelphia westward to Harrisburg, is 105.3 miles long and is divided into 51 block sections. One block, near Leaman Place, is 3.9 miles long and two others, about 20 miles east of Harrisburg, are 4 and 4.3 miles, respectively; but throughout the rest of the division the lengths are much less. For example, from Philadelphia to Glen Loch, 25.3 miles, the block stations are those with which a telegraph call is shown in the following table:

PENNSYLVANIA RAILROAD—PHILADELPHIA DIVISION.

	Dist. from Phila.	Dist. from last block station.	Telegraph Signal.
Powelton Avenue	1.4	.....	.....
K Block station	1.9	1.9	K
C R Block station	2.7	0.8	C R
G V Block station	3.2	0.5	G V
52d Street	4.0	0.8	52
O B Block station	4.9	0.9	O B
Overbrook	5.5	.....	.....
Merion	6.0	1.1	M R
Narberth	6.9	0.9	M Q
Wynnewood	7.5	0.6	W D
Ardmore	8.5	1.0	D J
Haverford	9.2	.....	.....
Bryn Mawr	10.2	1.7	W H
Rosemont	10.9	.....	.....
Villa Nova	12.0	1.8	N G
Upton	12.4	.....	.....
Radnor	13.0	.....	.....
St. Davids	13.8	1.8	R
Wayne	14.6	.....	.....
Strafford	15.5	.....	.....
S Z Block station	15.9	2.1	S Z
Devon	16.5	.....	.....
Berwyn	17.6	.....	.....
O V Block Station	18.0	2.1	O V
Daylesford	18.6	.....	.....
Paoli	19.9	1.9	P A
Green Tree	21.0	.....	.....
Malvern	21.6	.....	.....
M V Block station	22.1	2.2	M V
Frazer	23.6	1.5	F Z
Frazer	23.9	.....	.....
Glen Loch	25.3	1.7	G H

At the entrance to a block, A B, Fig. 1, is a semaphore signal, *a*, by which the signalman or operator can control passing trains. This semaphore, shown in Fig. 2, is worked by a lever in the cabin, connection being made by an iron rod (gas pipe) or by wires. To stop a train the arm of the semaphore is put in the horizontal position (*a*, Fig. 2); to indicate that the block is clear it is put in the inclined position (*b*, Fig. 2). The Pennsylvania formerly used, in block signaling, a disk, which was shown at or withdrawn from an opening in a box, but the semaphore has been standard for many years.

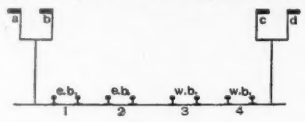


Fig. 4.

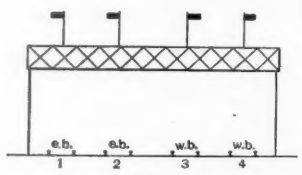


Fig. 5.

On the approach of a train going east (bound for New York) the signalman in cabin *c*, at station A, if there is no train on that track between A and B, puts the arm of the signal, *a*, in the inclined position, which informs the engineman that the track is clear as far as signal *b* at B. The train proceeds and, after it has passed, the signalman puts his signal back in the stop position. After the train has passed the signal at B, the signalman there notifies A of the fact, and signal *a* may then be lowered whenever needed for another train.

At each signal station or cabin the signalman keeps a record of trains in form like that on the opposite page.

This form facsimile shows the first few lines of one-half of a signalman's daily report, the other half (showing westward trains) being in similar form. The engraving is reduced somewhat from the actual size, and the column for remarks is wider, in proportion to the other columns, than is here shown. The sheet has a space for recording the state of the weather three times a day, and each operator records on it his name and the hours during which he serves, thus: J. Smith, 12 midnight to 7 a. m.; P. Jones, 7 a. m. to 7 p. m.; Smith, 7 p. m. to 12 midnight. "Da" is the station west of Franklin Park and "Cn" is the station east. The engine numbers without train numbers denote freight trains not scheduled. The blanks in certain items, as, for example, engine 1,561 at Cn, are due to the fact that at this point the freight tracks, Nos. 2 and 3, are not ordinarily block-signaled.

The signalman's cabin *c* is usually a two-story frame building about 12 ft. x 15 ft., the office being in the second story, where can be had a good view over the tops of cars. Where there are switches the cabin is made larger, to give room for the interlocking frame. At some very small stations the signalman, who also is the only telegraph operator at the station, is in the station building, on the ground floor. The levers for working the signals stand in the middle of the cabin and the connections run out through the basement. Aside from the levers the only apparatus used by the signalman is the common Morse telegraph. He keeps white, red and green flags, and lanterns of the same colors, for use in case the regular apparatus should fail.

Figs. 3, 4, 5, 6, 7 show different arrangements of signals. In Fig. 3 the arms for both eastbound and westbound are on one post, and one lamp placed between the two arms answers for both. If the signal is south of the tracks it must be high enough, so that enginemen passing on the north track can conveniently see it over the top of an eastbound train.

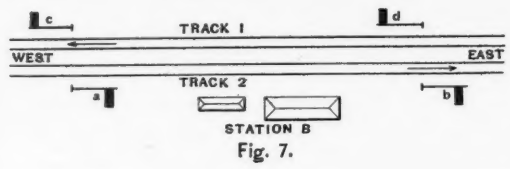


Fig. 7.

Fig. 8.

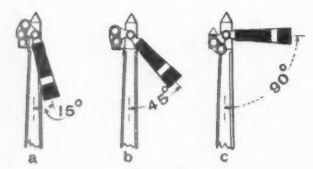


Fig. 9.

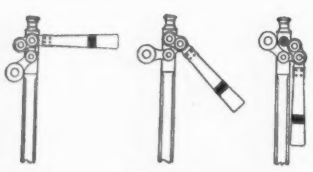


Fig. 10.

NOTE—The semaphore signal (Fig. 2) is usually from 20 ft. to 30 ft. high. The arm is of wood and the post usually of wood, although tubular iron posts have lately come into use. On most roads the front of the arm is painted red, but yellow is the color used both for home and distant signals on the Pennsylvania Lines West of Pittsburgh and on the Cincinnati, New Orleans & Texas Pacific. The color of a semaphore, however, has no significance to the engineman. Distant signals are usually painted green. White is the most common color for the backs of all signal arms.

It is the rule to set semaphores at the right hand side of the track which they govern, and the arm always extends or hangs at the right side of the post. The counter weight, fixed to the balance lever below the signal, is designed to insure that, in case of breakage of the wire or other connection between the cabin and the signal, the the signal arm shall move to the horizontal or "stop" position if it is not already there.

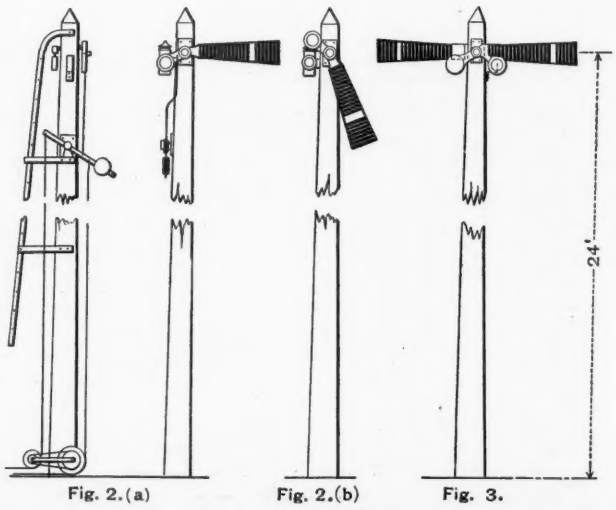


Fig. 2.(a) Fig. 2.(b) Fig. 3.

American Practice in Block Signaling—Typical Arrangements of Signals.

On the Pennsylvania Lines West of Pittsburgh the signals on bracket posts are in some cases made of different heights for different tracks. Thus, if tracks 1 and 4 were used for passenger trains and tracks 2 and 3 for freight trains, the posts of signals *a* and *d* would be made 7 ft. higher than those of signals *b* and *c*.

In Fig. 6 the signals are placed east and west of the station, respectively, so that passenger trains, when stopped by the signal, will be in a convenient position to take and leave passengers. With signals arranged as in Fig. 3 or located as in Fig. 1, convenience requires a rule permitting passenger trains to run past a stop signal so as to stop at the platform and thus economize time whenever it is necessary to wait for the block section to be cleared.

In Fig. 7 *a* is called the home signal and *b* is the "starting" signal. With this arrangement, an eastbound train which has to wait for a preceding train to pass station C before signal *b* can be lowered to the "all-clear" position, can stand at the station, between signals *a* and *b*; and signal *a* being put in the stop position, the signalman (B) can notify station A to permit a following train to come on as far as *a*.

In Fig. 8, *d* is a distant signal placed 1,000 ft. west of the westernmost stop signal, to be used to repeat

In Figs. 4 and 5 there are four tracks, two westbound on the right and two eastbound on the left.

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the indication of the latter. This is to save the time of fast or heavy trains whenever, on account of fog, snow or smoke, or because there is a curve in the road, the home signal cannot be seen by an approaching engineman until he gets close to it. By being informed a thousand feet away that the home signal is "all clear" the engineman is saved the delay involved in slackening the speed of his train in order to find out in season whether or not it will be safe to pass the home signal. The distant signal is worked by a wire, strung alongside of the track, on short stakes, and its lever is interlocked with that of the home signal, and also that of the starting signal, so that the distant signal cannot be put in the clear position until both the others have been put in that position. And before the home and starting signals can be put back to the horizontal position the distant must be put back so as to indicate to an approaching engineman that he must expect to find the home signal at "stop."

PENNSYLVANIA RAILROAD.

DAILY RECORD OF TRAINS.

Franklin Park-Block Station, April 24, 1899.

Eastward

TRAIN	Eng.	Da		Ki				CM	REMARKS.
		D	Track	Track	A	D	Track	D	
70		209	1	1	215	217	1	221	
66		446	1	1	—	450	1	455	
	1561	450	2	2	—	505	2	—	
14		503	1	1	—	507	1	511	
	1060	515	2	2	—	522	2	—	
78		526	1	1	—	531	1	536	
10		601	1	1	—	605	1	608	
	728	602	2	2	—	610	2	—	
6		613	1	1	—	616	1	619	
	1042	625	1	1	—	632	1	640	

Distant signals are generally placed not less than 800 ft. nor more than 2,500 ft. from the home signal. Where the grade is descending it is customary to set the signal farther back than on level lines. Where two block stations are near enough together the distant signal of station B can be put on the same post with the starting signal of station A, the distant arm being placed below the "stop" arm.

Where block sections are long it may frequently be found desirable to move two or more trains, one after the other, nearer together than the length of a block. To provide for this a "permissive" signal is given, virtually suspending the block system for the time. The signalman leaves his signal in its normal or "stop" position and shows to the engineman from the window of the cabin a green flag or (at night) a green light, indicating thereby that the last preceding train has not yet gone out from the farther end of the block. The engineman who receives such a signal must move his train slowly enough to avoid the possibility of running into the preceding train. On straight lines, in clear weather he may be able to maintain the speed at the regular rate, but on curves, in hilly country he may have to reduce it to ten miles an hour, or even less, for the preceding train may have been compelled by some unforeseen circumstance to come to a full stop on a sharp curve, where the view from the rear is obscured.

Many of the signals on the Pennsylvania are arranged so as to give three indications, as shown in Fig. 9, thus enabling the signalman to give a permissive signal with the semaphore alone. The semaphore casting carries two glasses, a red and a green, the green being for the night indication of the position shown in *b*, Fig. 9.

The position shown at *a*, Fig. 9, indicates all-clear; that at *b* indicates that the preceding train has not cleared the block section.

On the Pennsylvania Lines West of Pittsburgh the three-position semaphore is so designed that in the all-clear position the arm will hang precisely vertical, as in Fig. 10. This arrangement makes a better distinction between positions *a* and *b*, while at the same time it avoids placing the arm exactly in line with the post. If, with the signal shown in Fig. 9, the arm were put in a vertical position, it would practically be hidden, and an approaching engineman would be in doubt whether it had not been accidentally broken off while in the stop position. It is a fundamental principle of all good signaling that the engineman shall receive positive information as to the state of the line.

[TO BE CONTINUED.]

An Old Chain Suspension Bridge.

By Malverd A. Howe.*

Although the old chain bridge which crosses a portion of the Merrimac River near Newburyport, Mass., has been briefly described in "American Railroad Bridges" by Mr. Theodore Cooper, yet some of your readers may be interested in a few of the data obtained by the writer last summer.

The first bridge built at the site of the present structure, and also the first bridge across the Merrimac River, was built by Timothy Palmer in 1792. The structure consisted of two bridges resting upon Deer Island. An arch of 160 ft. spand and 40 ft. above high water connected the island with the mainland on one side, and several spans did a like service upon the other. An illustration of this bridge is given by Mr. Cooper in the book mentioned above.

In passing, it may be said that an old legend relates that the island derived its name from the fact that a deer jumped upon it from the mainland across the channel. Passengers upon the old steamer Merrimac can even now see a pair of antlers fastened to a tree trunk standing upon the island a little above the bridge, said to be the antlers of the deer which made the remarkable leap.

The present chain bridge replaced the 160-ft. arch in 1810, and was built by John Templeman of the District of Columbia. According to the tablet upon one of the towers this was "the first chain suspension bridge built in New England."

The distance between the centers of the towers is about 244 ft., and the length of the roadway carried by the cables about 230 ft. The towers above the roadway are built of heavy timbers protected with a shingled covering.

The bridge consists of two independent roadways, side by side, each about 12 ft. in the clear; each roadway is carried by two sets of cables, each set being composed of three chains made of links 24 in. long. The material of which the links are made is wrought iron 1 in. square, making the total area of each cable 6 sq. in.

The floor system is of wood. The floor beams are about 6 in. wide x 12 in. deep and are carried in wrought iron stirrups made of flat iron about ⅝ in. thick and 3 in. wide; these are fastened to the suspenders by an eye connection. The vertical suspenders have each an area of about 1 sq. in., and are made up of a mixture of square and flat iron.

The upper end of each suspender is attached by an eye to a piece of iron 1¼ in. x 1¼ in. which, with the ends turned down for about 2 in., straddles the three chains, being kept in position by a hook inserted in a convenient link of the chain.

Five floor beams in the center of the span rest on top of the chain cables. There are seven lines of tinuous for three panels, each panel being about 7 stringers for each roadway. They appear to be conft., and they are fastened to the floor beams with strap irons.

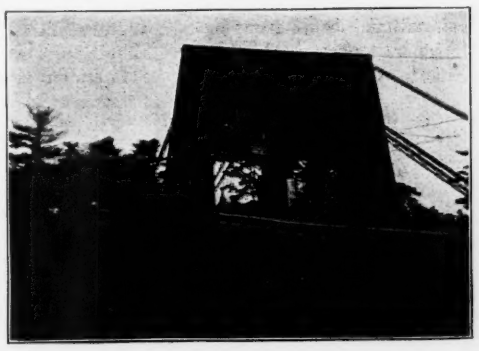
The anchorage is about 100 ft. from the towers and the cables run to the tops of the towers without any vertical load.

The slight vertical stiffness which exists is due to the continuous stringers and the side rails; the side rails have posts 6 in. square, top rails 5 in. square, and two intermediate planks 6 in. wide. The top rails alone are continuous. The cables hang in vertical planes and there is no lateral bracing of any kind other than the floor planking.

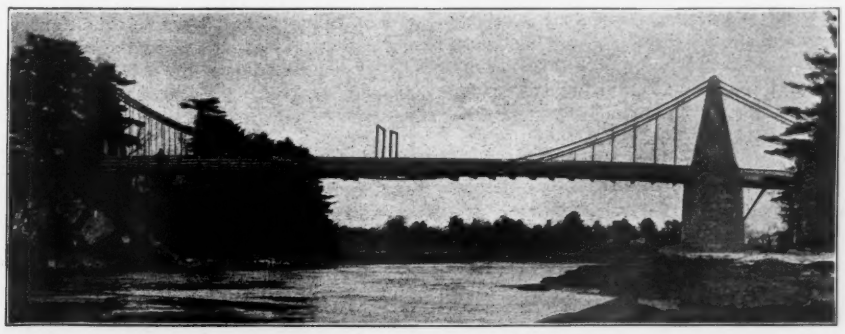
Electric cars have crossed this bridge some eight years, a line of rails being laid in each roadway. To one who has not experienced seeing the rails rise up in front of the car as it moves forward and downward, the sensation is anything but pleasant at first. A light summer car in the center of the span causes a vertical deflection of at least 2 ft. A car crossing the bridge as viewed from a boat upon the river a little above the structure gives a beautiful illustration of wave motion.

On the writer's first trip across the structure in an electric car, he wouldn't have been surprised had the car left the rails, but he was surprised, after reaching Deer Island, to experience a derailment. In the modifications which are contemplated to prevent so much wave motion in the floor, it is to be hoped the general appearance of the structure may be preserved.

*Professor of Civil Engineering, Rose Polytechnic Institute Terre Haute, Ind



An Old Chain Suspension Bridge,



An Old Chain Suspension Bridge near Newburyport, Mass.

Life of Steel Wire Cables.*

Mr. E. H. Benjamin, Secretary of the California Miners' Association, has begun, in co-operation with the testing laboratory of the University of California, a series of tests which should prove of great practical use to all persons making extensive application of steel wire cables. Mr. Benjamin is endeavoring to obtain pieces of cable, both new, and old and worn, from every deep mine of importance on the Pacific Coast, together with all the data obtainable concerning their manufacture and particular use. Pieces from each sample will be broken in the laboratory before mentioned, and as far as possible the effects of winding around drums or pulleys; of sudden starting and stopping when loaded, of heavy shocks, and of the general wear and tear of the cables, will be ascertained by these tests. The Olsen testing-machine of 200,000 pounds capacity will be used to break the cables, and the rupturing force, in different instances, will be applied slowly and also rapidly, in order to make the tests comparable as far as possible with the practical use of the cables themselves.

All information and data available should be obtained for each specimen sent to the laboratory, the name of the manufacturer, the date of making, strength of cable when new and unrusted, as well as the circumstances and conditions of the practical use of the cable. Having this information before us, we shall be able to tell, approximately at least, the effects of age, rust, wear and tear, shocks, etc.; and perhaps be enabled to draw the line of limitation beyond which it would be no longer safe to use a cable of known manufacture.

From the small number of tests already made we may, perhaps, be justified in drawing a few general conclusions; namely, (1) that the effect of ordinary rust on the strength of steel wire cables is not as great as has commonly been supposed, and that the rusting may be almost entirely prevented by carefully coating with tar, etc.; (2) that the weakening effect of bending the cable around a drum, of large size compared with the diameter of one cable, is almost nothing; (3) that the cable which exhibits a great deal of wear on its exterior surface, and is apparently much diminished in strength, is not nearly as much weakened as is commonly supposed, and retains a large percentage of its original strength, particularly when stressed by gradually increasing loads, applied without shock.

These conclusions are no more than provisional, having been drawn from a small number only of tests, and may be greatly modified in the final report.

*By Prof. Frank Soulé, University of California, Berkeley, Cal., Transactions of the American Institute of Mining Engineers.

RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.

PUBLISHED EVERY FRIDAY,
At 32 Park Place, New York.

EDITORIAL ANNOUNCEMENTS.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to improvements. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

In our news columns during the month of December orders for 13,983 cars of all kinds and for 432 locomotives were noted. Of the cars 731 will be built by the railroads at their own shops. Of the entire number ordered, 7,404 were box, stock, furniture and refrigerator cars; 3,075 were coal and gondola cars; 1,675 were flat cars; 1,500 were steel cars; 20 were tank cars and 309 were for passenger and street railroad service. Of the 432 locomotives noted, 10 were for export and the division of types was approximately, 107 passenger locomotives, 279 freight locomotives and 46 switching locomotives. This summary shows an increase in cars ordered over the November record of almost 24 per cent., while the increase in locomotives ordered is 10 per cent. The increase of the December over the June record, is about 3¾ times as many locomotives, and about 2¾ times as many cars. As orders under consideration so late in the year are commonly held over until early in the new year, such an increase in December orders was larger than expected. It is understood that a number of orders will be placed in January, as deliveries next spring and summer are the best obtainable in many cases, especially for locomotives.

From a statement published in the Philadelphia Press it would appear that the Philadelphia & Reading has nearly, or quite, recovered the loss sustained by its suburban passenger traffic on the establishment of electric street car lines in the vicinity of Philadelphia five years ago, and a good portion of the increase from the lowest ebb of the business in 1894 seems to have been made within less than four years. The first important competing electric line was that between Philadelphia and Tioga, four miles, opened in March, 1894; a little later a line was opened to Wayne Junction, five miles, then to Germantown, seven miles, and in February of the next year to Chestnut Hill, 11 miles. About the same time Jenkintown, 11 miles, and Willow Grove, 15 miles, were connected with the city. A marked falling off at once occurred in the traffic of the steam railroads, that of the Pennsylvania (where paralleled) as well as that of the Reading. The first action taken by the Reading was a reduction in fares on April 1, 1895; and two and a half years later still further reductions were made. The number of suburban trains has also been increased. Fares which were formerly 15 cents were reduced to 10, and those of 25 were reduced to 15; and for long distances still more. To and from Willow Grove, the single trip was reduced from 47 cents to 20, and the round trip from 63 to 35. The result of these reductions and of the increase in accommodations is now summarized in the statement that the earnings on the suburban traffic are now better than they were before the street competition began. The restoration of gross earnings to the figures of 1893 appears to have been accomplished two years ago, but now the improvement has become so marked that the net earnings are also declared to be satisfactory. The fares on the Reading have at all times been kept just a trifle higher than those of the street-car lines for the same distances.

The Signal Engineer.

The position of the signal engineer is still in a somewhat plastic and unformed stage. On many railroads he does not exist at all; his duties are performed by division superintendents, maintenance of way engineers, roadmasters and even section bosses. Elsewhere he exists, but his rank is low and his pay small, and he is not in the line of promotion. On a few railroads in the United States his real importance is recognized, but even there some among the superior officers or directors do not look upon him as an indispensable member of the staff to be provided for, paid and promoted like other engineers. All of this is not a matter to complain about, but to recognize and to analyze with a view to try to forecast somewhat the future.

It is rather trite to say that only within quite recent times has the signal engineer been recognized as a real engineer. Several of us have said this several times within the last dozen years, but it is still true, and, further, we venture the assertion that signal engineering is not yet estimated at its actual value as a special branch of engineering.

The proper signaling and interlocking of a level crossing or of a double junction is now a simple stock matter. You can buy it of the maker much as you would buy a suit of clothes. In either case there will be some small percentage of misfits and alterations, but in general you are ordering a staple article out of stock. The actual design and execution of such a piece of work requires neither originality nor ability beyond that of a shop foreman.

In block signaling, however, the opportunity for the sort of investigation, analysis and adaptation which we call engineering is greater. The signal engineer must there determine the kind of signaling to be used, or he should furnish the knowledge and judgment which will enable his superiors to determine that. Perhaps under existing conditions it will be best to use the simple manual block; perhaps it will be best to use the controlled manual; perhaps it will be best to use an automatic system with track circuit and banjo signals; perhaps it will be best to use the automatic electric semaphore, or an electro-pneumatic semaphore. Complicating all this are several important questions of detail involving the financial condition of the road and the density, speed and kind of traffic. Shall the blocks be 10 miles long or shall they be one-third of a mile long? On different parts of the line they may be of different lengths, depending upon several elements. And when all these questions are settled the engineer has still to decide whether he shall use the old, stock, signal lights, or shall use red and green and yellow, or shall introduce form by the use of more than one light for any one indication. All of these matters involve experience, knowledge and judgment of a highly specialized quality. But this is not all.

The problems of safe, quick and cheap movement of trains at great yards and terminals give the modern signal engineer a chance to distinguish himself and to serve his company with profit to that company. Here we meet a set of conditions which call out not only the highly specialized knowledge of the signal engineer and of the superintendent in charge of operation, but which also call for trained powers of analysis and for clear and sound reasoning and for original contrivance. They call, in short, for engineering of a high grade. The American Society of Civil Engineers prescribes that for admission to membership a man shall, among other things, "have had responsible charge of work for at least five years and shall be qualified to design as well as to direct engineering works." To adequately signal a great terminal is an engineering work of a pretty high class, and it requires power to design. The man who can do this work well is, so far, qualified for full membership in the Society. Bad design there will lay upon the work of that yard a burden, the cost of which would pay the salary of a high class engineer.

The investment in signals has now run up into big figures, even although but a small percentage of our railroads are block-signaled. Furthermore, we rely more, year by year, on signals for safety and despatch in operation. The cheap and efficient maintenance of the signaling plant and the discipline and efficiency of the signaling personnel become, therefore, more important as time goes on, and the signal engineer, to fill the requirements of his position, must be a good executive man as well as a technical engineer. He must develop the sort of talent that is best paid in the world, the administrative talent.

But back of all this is a principle not yet much recognized, but which will soon begin to affect the standing of the signal engineer and should give him higher rank and pay. So far, signaling has been looked on as a means of preventing collisions. It has been merely a safety measure. This, however, is only one of its functions; it has another duty now generally thought of only as incidental to its safety duty, but which will in course of time come to be recognized as a primary duty. Indeed this duty of the signal is so little considered that signaling is frequently installed in such a way as to retard rather than to advance its efficiency in performing this duty. This unrecognized second function of the signal is as an automatic spacer of trains on the track with a view to quicker movement as well as safer movement. Properly designed and worked, signaling becomes a means of getting trains out of yards and over the line not only safely but quickly. Thus it becomes a revenue gainer as well as a means of insurance. When this theory is better understood the signal engineer will be more invaluable to those who determine rank and pay. He will pass from the class of negative forces to the class of positive forces, with good results to himself and to the railroads.

The Advanced Trunk-Line Freight Rates.

The advances in through freight rates produced by the numerous changes in classification recently announced by the Trunk Lines and their Western connections, were put into effect on January 1, in spite of protests from numerous shippers. The hearing before the Interstate Commerce Commission Dec. 21 and 22 brought out little that was new except that the Commission evidently believes it inexpedient, if not outside its proper functions, to take any action on the classification and the complaints against it until after the change in rates has actually gone into effect. At the request of some of the shippers the Commission transmitted the testimony to the Attorney-General to enable him to proceed against the railroads represented in the Classification Committee, for violating the Anti-Trust law, but that officer refused to take action, as reported in another column of this paper. It is to be noted that representatives of New York shippers, Mr. Corwine of the Merchants' Association for one, refused to join the Western men in asking for action by the Attorney-General, believing that it would be better to try negotiation with the railroads. The traffic officers of the principal lines have already expressed their willingness to consider the complaints of those who claim that they are going to suffer serious losses by the advances in freights.

The principal witness on the part of the railroads who appeared at the hearing before the Commission was Mr. C. E. Gill, Chairman of the Official Classification Committee. He explained what had been done by the Committee, but nothing appears to have been said as to the precise mode of procedure taken by the roads to put the classification into effect; and, as appears from the Attorney-General's statement, the record transmitted to that officer gives no evidence whatever that the railroads entered into any combination or agreement or that they are in any way bound to adhere to the new classification. There is, therefore, no infraction of the Sherman law. When Mr. Gill was asked on what grounds the railroads justified the increases in rates he replied simply that the higher cost of transportation and the growing activity in all departments of the commercial world justify an increase. Mr. Gill stated that many rates had not been touched and were still too low; these might be increased in the near future. The witness did not go into particulars, and gave no reasons for individual changes in the list. Generally speaking, the changes were restorations of rates to bases which prevailed several years ago. Commissioner Prouty asked questions designed to bring out the fact that in 1887 prices for railroad material were fully as high as they are now, while, it appears, the Committee aims to make freight rates on some articles higher than they were in 1887.

Mr. Kelly, of the Philadelphia Trades League, asked to have the new classification postponed until April 1, when he believed the changes could be made without trouble. Mr. Vanlandingham, of St. Louis, expressed similar views. Mr. Monnett, Attorney-General of Ohio, quoted tariffs showing that on some commodities the difference between carload and less than carload rates had been made exorbitant; on petroleum he said the difference was 269 per cent. Mr. Guilford, Traffic Manager of the New

York Central, was examined at length by the Commission, and declared the readiness of the railroads to correct any inequalities or injustice that might be found in the new classification. He protested against a postponement of the advances, because operating expenses are now constantly increasing and three months' delay would cause a decided loss to the roads. Near the close of the session the representatives of the New York merchants tried to have the hearing adjourned, believing that a compromise could be made with the railroads. The Commission's letter to the Attorney-General contained no recommendations, and stated that the Commission had no authority to grant relief to the shippers in a case of this kind.

Nothing could be clearer than the reasons given by the Attorney-General for refusing to try to annul the classification. Under the absurd Anti-Trust law it would have been possible for a wrong-headed public officer to make a case against the railroads on almost any trivial ground that his fancy might dictate. A conspiracy need not be in writing, and under the law laid down in the decisions heretofore rendered it might with considerable plausibility be charged that the railroads are already guilty of illegal action. No trial by a court is necessary to convict them, as the very fact that they have met to consider a uniform classification, convicts them of trying to mitigate competition. There is no evidence that the different companies have agreed with one another to adopt the classification, but if any two of them do adopt it, and thereby make uniform rates, a Populist judge would be likely to hold that they had carried out their conspiracy. The ideal competition, the kind required by the Sherman law, would demand the abolition of all printed classifications so that competition in rates could be made frankly barbarous.

In one view of the case it might seem desirable to have a case of this kind brought to trial, so as to bring clearly before Congressmen and the public the absurdity of the Sherman law as an instrument for regulating commercial affairs; but the Attorney-General evidently does not deem it a public duty to do so in this instance. After the new classification and the resulting advances in rates have been in force for a time it will be possible, of course, for the merchants to renew their application; and, so far as the statute is concerned, the absurdities of the Trans-Missouri and Joint Traffic cases may be repeated. Possibly such repetition will be the only thing that will convince Congressmen of the irrational nature of the Sherman law as applied to the regulation of freight rates; though, so far as we can see, there is little hope of ever getting a thorough judicial discussion of this matter. If a bench of judges decide that the question of fact, whether trade is really restrained or not, should govern in deciding a case under the Act, it is plain that they are ignoring the letter of the statute; while on the other hand, if the position of Justice Peckham is taken, it is necessary to admit, as he did, that blind adherence to the letter is the only rule by which the Court can be guided. In either case the decision would be unsatisfactory; for if it is based on reason it is likely to be repudiated, as a precedent, in the next important case that comes before a strict-constructionist judge; while a decision based on the rigid letter of an unreasonable statute is of little value as a precedent because the judge who writes it will not try to set forth arguments to justify himself.

If the real question at issue between the complainants and the railroads were to be brought to judicial determination it would involve probably a hundred suits, at least. There are two classes of complaints. The first is that the increased cost of transportation will cause a loss on contracts which shippers have already made with buyers. This is a temporary matter, and the demand was that the advance should be postponed three months. Inasmuch as the law requires only 10 days' notice of an advance, and this change was generally known a month ago, it would seem that the legal basis of the merchants' demand must be pretty slim.

The second class of complaints is based on the increased difference between carload rates and those for less than carloads. (This does not apply in the case of the most important commodity, sugar, as in that the difference is made less instead of more.) This point may develop a controversy. It was the subject of a long drawn out investigation by the Interstate Commerce Commission away back in 1890. On this point judges and jurymen can form definite opinions, as they cannot on such questions as whether cotton cloth can bear an additional freight charge of a fifth of a mill per yard.

The legitimate grounds for a difference between CL and LCL rates are two—difference in cost and the promotion of economy. The difference in cost is often very small, and at best it can be computed only in the crudest manner, for the business of carrying small shipments involves a great amount of empty or half empty car mileage and running of certain cars every day when the volume of freight warrants only one or two cars a week. But this difference is about the only tangible point that can be used as an argument in this matter with non-railroad men, so that the railroads will probably have to be exceedingly liberal with the shippers in order to avoid a bitter controversy. Indeed, the excessive liberality of the railroads in the past toward shippers of very small lots of groceries from New York to the West, is, we think, one of the reasons why rates have got into the unbusiness-like condition which has necessitated the present readjustment.

The question of economy, that is, of constantly working to make the cost of transportation as low as possible, is still harder to explain. Economy demands the utmost possible reduction of empty car movement. The astonishingly low prices that have been made by the railroads on grain and coal during the past five years have been made possible by carrying all shipments in full carloads; and the full loading of cars will produce a similar saving in the case of soap, coffee, stoves and many other things. It is for the interest of both carrier and consumer that the railroads make discounts to stimulate the shipment of goods in large lots. But the rightful extent of this discount is a knotty question, and if the question goes to the courts, it is likely to lead to a great amount of discussion with little profitable result. It is to be hoped therefore that the conferences between the railroads and the New York shippers will result in a speedy agreement. Every shipper who has complained has admitted that he was making greatly increased profits himself and that he had no objection to an increase in freight rates per se. This being so, the differences between large shippers and small shippers ought not to stand in the way of a settlement.

It has been hoped that an outlet for the coarse products of Siberia might be had not only through Archangel, over a route heretofore described, which, however, requires transportation over more than a thousand miles of railroad west of the Siberian Railroad, but directly from the line of the latter down the great Siberian rivers, the Obi and the Yenissei, to the Arctic Ocean and thence by sea. Some materials for the railroad have been brought that way, as iron for bridge construction; but the experience of the past summer indicates that it cannot be depended upon, and at best is likely to be costly, slow and dangerous. Last July five vessels were dispatched from London to the mouths of these two streams, which empty into the body of water called the Sea of Kara, separated from the body of the Arctic by the great island Nova Zembla. All efforts to enter the Kara Sea were in vain on account of ice until the end of August, and within it the masses of Polar ice were so great that the effort to reach the mouths of the rivers, there of enormous width, was abandoned and the vessels turned back. The return was still more dangerous, and one of the vessels was crushed in the ice and sunk with its cargo of 1,300 tons of tea, and all the other vessels were damaged. To encourage the opening of this route the Russian Government had agreed to admit many goods duty free, and tea, largely consumed in Siberia, at a reduced rate. There is no necessary connection of this route with the Siberian Railroad. The streams in question have thousands of miles of navigable waters in Siberia, no inconsiderable part of which is through a country possessing great forests and capable in the aggregate of producing great quantities of wheat or rye and cattle. Some hundreds of miles of their lower courses are through desolate "tundras," overgrown to a great depth with moss, and overflowed yearly, because this part of the streams remains solid ice long after their upper courses have thawed. The development of the country along the line of the railroad makes possible a production which would find a much cheaper outlet by water, if access to the river mouths were practicable, than over several thousand miles of railroad. Now it seems that the traffic of the rivers, as a rule, must be brought to the railroad and not to the sea.

The aggregate of bonds listed on the New York Stock Exchange during the year just closed is about 175 millions less than during 1898, in which year, however, the Government war loan of 180 millions was included. The aggregate of bonds for new capital, $156,304,760, however, is less than for any year of the decade, except 1893, 1896 and 1897. The aggregate of new stocks, amounting to $704,172,605, is more than double that of the five years from 1891 to 1895, and exceeds 1896, the year most nearly approaching it, by 113 millions. The increase in the amount of new stocks is due principally to the capitalization of the new industrials. The decrease in the amount of bonds for new capital is largely owing to a certain tendency of railroads to issue new stock for important purposes rather than bonds. For example, the Great Northern has raised the amount of its stock by retiring issues of subsidiary lines and in other ways from 50 to about 90 millions of dollars; the Central Railroad of New Jersey, the C. B. & Q. and the Chicago Great Western have each sold stock to obtain funds to lift maturing bonds, and the Illinois Central has completed the deferred sale of 7½ millions of stock. The total issues of stock and bonds for the decade are shown in the following summary of a table covering the issues for each year which appeared in the Financial Chronicle of Dec. 30:

	New issues.	Old issues newly listed.	Replacing old securities.	Total.
Bonds.....	$1,691,853,892	$296,236,379	$2,323,319,730	$4,311,410,000
Stocks	1,076,424,955	226,581,297	2,476,784,078	3,782,789,331

NEW PUBLICATIONS.

Heat and Heat Engines. A study of the principles which underlie the mechanical engineering of a power plant. By Frederick R. Hutton, E.M., Ph.D., Professor of Mechanical Engineering at Columbia Unversity. New York: John Wiley & Sons, 1899. 576 pages and 198 illustrations, 8vo. $5.00.

This book was written for a text-book and should be reviewed by someone who has used it as such in the class-room, if a fair estimate is made of its value for instruction in heat engines. Unfortunately, we cannot speak of it from such experience. It will be read and consulted, however, by many practicing engineers, and by others who desire to review the general principles of the subject and become familiar with some of the most recent developments in heat engine practice.

The author aims to lead the student through a systematic analysis of those principles of physics and dynamics on which power house machinery depend, and to tell how engineers proceed in the design of such machines as steam, gas, compressed-air and hot-air engines. He writes for the average rather than the critical student, and consequently does not attempt to give any extended mathematical discussion.

The book occupies a middle ground between the very elementary and the rigid analytical treatises on thermo-dynamics and ought to fulfil the expressed desire of the author and be useful to that growing class of persons who are brought into touch with engineering matters and are anxious to learn about them, but yet who are not fitted to profit by an exclusively mathematical discussion. It can hardly be expected to do more than this. Some competent to express an opinion believe that the student in the technical schools can master a much heavier work on this subject—one that will require all their knowledge previously obtained in analytical geometry and the calculus. It may not be out of place to remark in passing that we are not altogether in sympathy with the attempt to study the science of thermodynamics without the calculus or with just as little as can be used, and still call the book a text-book. Is such an effort worthy of the usual high requirements of the technical schools of to-day? We leave it for the teacher to answer.

Prof. Hutton's book contains 23 chapters, among which are the following: General Notions of Heat, Fuel, Draft; Steam, Temperature-Entropy Diagrams for Heat Engines, Compressed and Hot-air Engines, Gas and Oil Engines and Mechanical Refrigeration. There is a bibliography of the subject at the close of the book which, with the accompanying notes, contains references to all of the important literature on the subject ever printed.

The book as a whole is well written and the subjects discussed are brought up to date. The feature which distinguishes it from other American text-books on the subject is the treatment of the entropy-temperature method of analyzing heat engine problems. The author has brought together much good literature on this subject, and has made some important applications of it. Many engines are analyzed by this method, although not to the exclusion of the analysis by the aid of mathematics, where the author regards the latter as important. The only criticism possible in a book of this character of giving so much space to this new method of analyzing heat engines, is that the student may be led away from the A B C principles of the science; but opinions may differ on this point.

We do not regard as very serious the imperfections in this the first edition. Some of the definitions, as, for example, those in connection with the topic of specific heat, are open to criticism; some of the illustrations are poor trade catalogue cuts, as in the discussion of injectors, and the author has not been as careful as the importance of the work demands in treating of some subjects. The chapter on The Rate of Combustion, for example, can be somewhat improved in another edition. The most serious fault of the book is that it has not been sufficiently boiled down and it contains discussions on some subjects

of secondary importance. For example, three pages are given to an explanation of the Wellington series engine and an entropy-temperature diagram has been worked out for a combination of the series principle wherein a gas engine and a steam engine are operated so that the rejected heat from the gas engine shall be used to make steam for the secondary cylinder. Could not the space have been given to a more practical and profitable study?

The author is suggestive and the student will become interested in many of the well-presented facts and in the development of the theory on which the science rests. Those desiring to obtain reasonably accurate information on the latest developments in this subject will find the work useful. It may profitably be studied to obtain a good knowledge of the principle on which heat engines work, and is an excellent introduction to the more serious work on the subject.

A Primer of the Calculus. By E. Sherman Gould, M. Am. Soc. C. E. Second edition, revised and enlarged. New York; D. Van Nostrand Co. 3½ x 6 in. Price, 50 cents.

This is No. 112 of the Van Nostrand Science Series and the first edition was reviewed by us early in 1897. At that time we raised the question if the author did not cover too much ground, although no criticism was offered of the matter presented. This book, while not intended in any way as a text book, may prove of considerable practical use to anyone desiring to review the elementary principles of the calculus and to study anew some of its many applications.

In his preface to the second edition, the author says that one whose opinion always carries weight urged that parts of the book be rewritten in order to base the theory of the method of limits instead of infinitesimals. It is fortunate for the reader that the author did not accept the suggestion. The infinitesimal method is sufficiently abstract for most of us, and while the method of limits may be more attractive to the mathematician, it could hardly be as acceptable to the average reader as the method usually taught in the schools and followed in this book.

Fowler's Mechanical Engineer's Pocket-book for 1900. By William H. Fowler, Wh. Sc., Am. Inst. C. E., etc. Manchester (Eng.); Scientific Publishing Co. Price, 1s. 6d. net (37 cents).

In this edition of Fowler's Mechanical Engineer's pocket-book the editor has carried out the general plan of previous editions, and the book as it now appears is more complete, nearly 200 pages having been added. The data in this book have in some part been compiled from original sources and corrections have been made, while much has been recast. Notable among the corrections is the adoption of 778 in place of 772 as the mechanical equivalent of heat. The subject of steam boilers has been extended and, on the whole, improved. A diary for 1900 and diagram forms for graphic records are given in the last few pages. The book is well bound and the low price is made possible by the large number of advertisements which it contains.

Hydraulic Diagrams. By Charles H. Swan, M. Am. Soc. C. E., and Theodore Horton, Jr., M. Am. Soc. C. E. New York; Engineering News Publishing Co. Pages, 43. Price $1.00.

This book contains diagrams based on the formula of Ganguillet and Kutter, and is intended for use in the study of such sections of conduits and canals as are commonly used in sewerage, water power and land drainage work. The diagrams have been made to include conduits of eight different types of cross section and canals of rectangular and trapezoidal cross sections. In presenting this work the authors have aimed to cover the field with as few diagrams as will readily conform to a simple and practical system for common use. The typographical work is well done and the explanations which we have examined are clearly given.

Transactions of the American Society of Mechanical Engineers. Vol. XX, 1899. New York: Published by the Society, No. 12 West 31st St.

This volume of the Transactions is 1,026 pages, including the index. The New York meeting, Nov. 29 to Dec. 2, 1898, and the Washington meeting, May 9 to May 12, 1899, are reported in the volume. Of course the reader is familiar with the fact that these volumes contain the business proceedings at the various meetings and also the papers and discussions.

The Practical Engineer's Pocket-book for 1900. Compiled by The Practical Engineer. London; Technical Publishing Co., Limited; New York, D. Van Nostrand Co. Price, 1s. 6d. net (37 cents).

This is the eleventh edition of an annual publication for engineers, and differs but little from earlier editions, the nature of the carefully arranged matter for ready reference being probably familiar to the reader. The index is satisfactory and the matter, as a whole, has been carefully prepared.

Roadmasters' Association.—The Proceedings of the seventh annual meeting of the Roadmasters' Association of America, held at Detroit, Mich., last September, have just been issued. The reports and discussions make a book of 141 pages, which can be obtained from the Secretary, Mr. J. B. Dickson, Sterling, Ill.

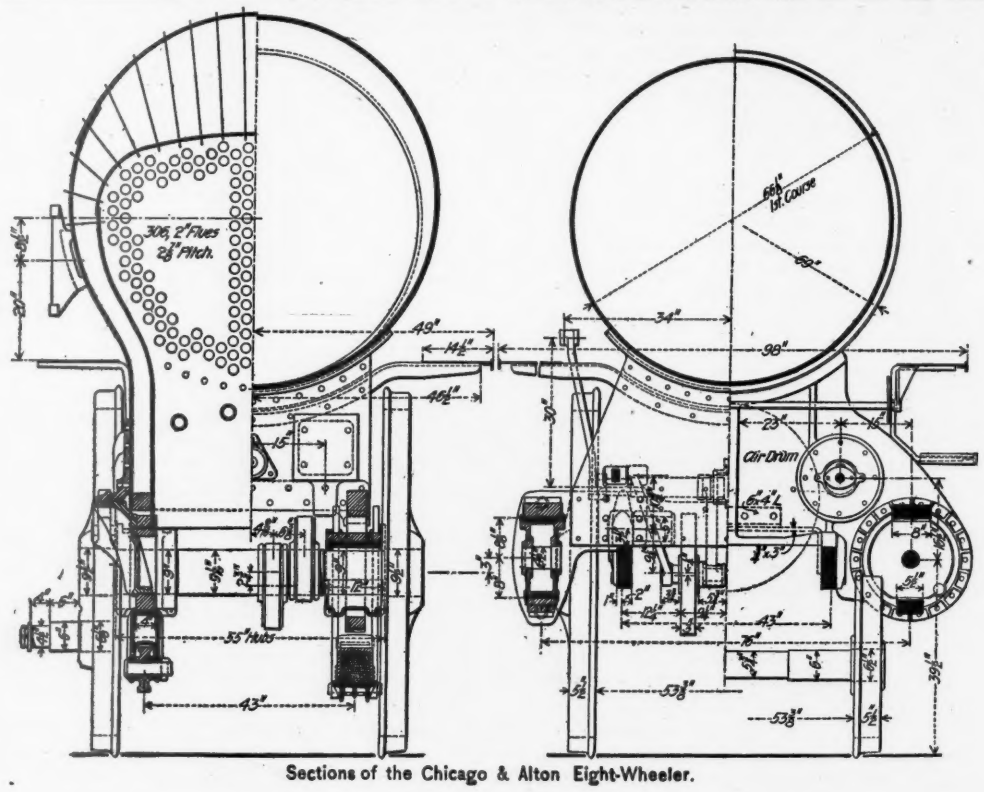
Chicago & Alton Eight-Wheel Passenger Locomotive.

The Chicago & Alton has recently received, from the Brooks Locomotive Works, 12 eight-wheel passenger locomotives for fast service, some of which will be used in connection with the new day trains run between Chicago and St. Louis. With this in view, the engines have been designed and ornamented to correspond with the standard car practice of the Pullman Company, the same contour lines being followed in the design of the cab as are used for the coaches. This is expected to give solid trains a more uniform and handsome appearance than where the locomotives and cars are painted different colors and have different contours.

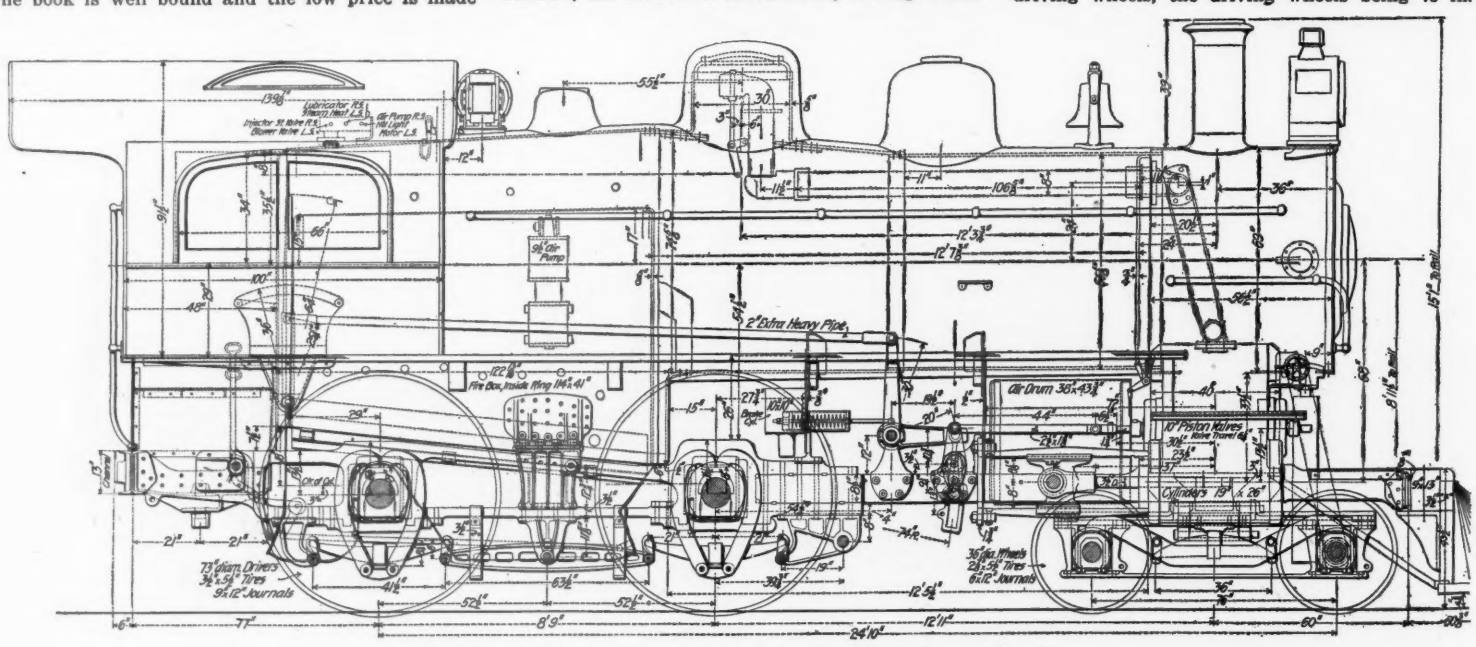
It may be noted that these new trains consist of one postal car, 66 ft. long, and five coaches each 72 ft. 6 in. long, and the 284 miles between Chicago and St. Louis is scheduled to be run in 7 hours and 59 minutes on the south-bound trip, 13 station stops being made. The return trip is made in 7 hours and 54 minutes with two more station stops.

The principal features of these engines are shown by the accompanying engravings. The total weight in working order is 139,000 lbs., with 90,500 lbs. on the driving wheels, the driving wheels being 73 in. in diameter and the cylinders 19 x 26 in. The boiler is of the radial stay wagon top type, designed to carry 210 lbs. steam pressure. The firebox is above the frames and has 177 sq. ft. of heating surface; there are 200 sq. ft. of heating surface in the tubes, although but 12 ft. 7⅜ in. long, making a total heating surface of 2,177 sq. ft. The grate area is 31.8 sq. ft. The tender loaded weighs 120,000 lbs. and has a capacity for 6,000 gallons of water and 12 tons of coal.

Attention may be called to the driving axles, which have enlarged wheel fits, 9½ in. in diameter, and



Sections of the Chicago & Alton Eight-Wheeler.



Eight-Wheel Passenger Locomotive for the Chicago & Alton Railroad.

Mr. H. Monkhouse, *Superintendent of Machinery.* *Built by the* Brooks Locomotive Works, *Dunkirk, N. Y.*

journals 9 x 12 in.; the weight per driving wheel is about 22,600 lbs. The portion of the main frames, which extends beyond the rear end of the boiler, is reduced in width from 4 in. to 1½ in., so as to form a solid slab tapered to connect with the 13-in. cross channel at the end. In a similar way the front rails are made 3 in. wide and 8½ in. deep. The cab has large sliding windows and the steam pipes for the injector, blower, lubricator, steam heat apparatus, air pump and electric headlight motor, are all connected with a single turret on top of the boiler inside the cab. The piston valves are 10 in. in diameter with 6¼ in. travel. Cast steel has been used largely in place of iron castings and forgings, and care has been taken to design these castings with a view to their appearance as well as strength. This is shown in the spring rigging, the parts of which are cast steel, the rocker boxes, arms and other parts of the valve mechanism, and the draw head and deck casting at the rear. In addition to these and such parts as driving wheel centers, driving boxes, and crossheads, there are numerous brackets and small pieces of cast steel.

Westinghouse high speed brakes are used and the air reservoir on the engine has a capacity of 50,000 cu. in., each driver is braked on the rear side, and, in addition, brakes are used on each wheel of the front truck. The other special equipment includes a 9½-in. Westinghouse air pump, Detroit lubricators, Knuckle safety valves, Hancock composite inspirator, A. French springs, Jerome metallic packing and Pyle-National electric headlights. All steel castings were furnished by the Pratt & Letchworth Company, and the driver brake shoes by the Sargent Company.

The following are dimensions not previously given:

Gage	4 ft. 8½ in.
Kind of fuel to be used	Bituminous coal
Wheel base, total, of engine	24 ft. 10 in.
" " driving	8 ft. 9 in.
" " total, engine and tender	53 ft. 2½ in.
Length over all, engine	38 ft. 7⅝ in.
" " " total, engine and tender	64 ft. 3⅝ in.
Height, center of boiler above rails	8 ft. 11½ in.
" of stack above rails	15 ft. 1 in.
Drivers, material of centers	Cast steel
Truck wheels, diameter	36 in.
Journals, driving axle, size	9 x 12 in., with enlarged wheel fits
" truck axle	6 x 12 in.
Main crank pin, size	6 x 6 in.
" coupling pin, size	4½ x 4 in.
" pin, diameter wheel fit	6½ in.
Piston rod, diameter	3½ in., with enlarged ends
Main rod, length center to center	105 in.
Steam ports, length	21½ in.
" " width	2 in.
Exhaust ports, least area	50 sq. in.
Bridge, width	3⅛ in.
Valves, kind of	Improved piston
" greatest travel	6¼ in.
" steam lap (inside)	1⅛ in.
" exhaust lap or clearance (outside)	Line and line
Lead in full gear	None
Boiler, working steam pressure	210 lbs.
" material in barrel	Steel
" thickness of material in shell	11/16, ¾, ⅞ and 15/16 in.
" " " tube sheet	¾ in.
" diameter of barrel, front	66⅛ in.
" " " " at throat	75⅝ in.
" " at back head	66⅛ in.
Seams, kind of horizontal	Sextuple
" " " circumferential	Double
Crown sheet, stayed with	Radial stays
Dome, diameter	30 in.
Firebox, length	114 in.
" width	41 in.
" depth, front	79 in.
" " back	65 in.
" material	Steel
" thickness of sheets	Crown ⅜, tube ⅝, side and back ⅜ in.
" brick arch	Self-supporting
" mud ring, width	Back, 3½ in.; sides, 4 in.; front, 4 in.
" water space at top	Back, 4½ in.; sides, 5 in.; front, 4 in.
Grates, kind of	Cast iron rocking
Tubes, number	306
" material	Charcoal iron
" outside diameter	2 in.
" thickness	No. 12 B. W. G.
" length over tube sheets	12 ft. 7⅝ in.
Smokebox, diameter, outside	69 in.
" length from flue sheet	60 in.
Exhaust nozzle	Single
" "	Permanent
" " diameter	4⅞, 5 and 5⅛ in.
" " distance of tip above center of boiler	1 in.
Netting	Wire
" size of mesh	2½ x 2½ in.
Stack	Steel taper
" least diameter	13 in.
" greatest "	14⅞ in.
" height above smokebox	39 in.

Tender.

Type	Eight-wheel, steel frame
Tank, type	Slope top
" material	Steel
" thickness of sheets	¼ in.
Type of under frame	13-in. steel channel
" " truck	B. L. W. 100,000 lbs.
" springs	Triple elliptic
Diameter of wheels	36 in.
" and length of journals	5 x 9 in.
Distance between centers of journals	66 in.
Diameter of wheel fit on axle	6⅝ in.
" " center of axle	5⅝ in.
Length of tender over bumper beams	23 ft. 8½ in.
" " tank	22 ft. ½ in.
Width " "	9 ft. 8 in.
Height " " not including collar	63 in.
Type of draw gear	M. C. B. Janney

Railroad Charters.*

By Prof. B. H. Meyer, University of Wisconsin.

The term railroad charter as used in this paper embraces the enabling or permissive statutes under which the railways of the country do business. The charters granted in the various states before general railway incorporation laws had been enacted were special laws relating exclusively to a particular enterprise. Railroad companies organized under general laws secured what are variously known as articles of incorporation, articles of association, letters patent, etc., which are in the old sense of the term not charters at all. The earlier "charters" are acts of special legislation. The later "articles" are merely administrative acts based upon general laws.

With the exception of a few western states, in which general laws were passed at the very outset, the states began with special legislation and gradually drifted into general legislation. In many states the first general laws embodied all the salient features of the best special charters which had been previously granted in those states, while in a much smaller number the first general laws related to eminent domain, declarations of public utility, public aid, and kindred topics, leaving the chief provisions of the franchise to the special charter. The transition from special to general laws was usually extremely slow. In a large number of states this transition was encouraged by a system of abbreviating charters, the new charter containing only several sections relating to the organization, route and other individual and local matters, with the provision that the company thereby incorporated shall enjoy all the rights, privileges and immunities previously granted to a certain other company. The logical outcome of this process was the enactment of a general law embodying the provisions of the charter by reference to which the newer charters had been abbreviated. However, the simple enactment of such a general law was not necessarily followed by incorporations under this law; for, again and again, special charters were granted—sometimes within a day or two—by the legislature, of a number of states, completely ignoring the general law. Of, perhaps, a score of railroad companies authorized during the same session of the legislature, one-half might have organized under general, and the remainder under special laws. More than this, one of the great railroad systems of the United States is to-day operated under a special charter, originally granted, twenty-five years before, for the construction of an insignificant local road which was never built, in spite of the fact that every state which this system crosses had at that time laws or constitutional provisions, or both, prohibiting the granting of special charters for railroad purposes. In itself this may have been neither bad nor good, yet we are confronted by the fact that the spirit, if not also the letter, of the laws of these states was shrewdly evaded by the railroad company in question.

The history of railroad charters in the different states has been quite similar. Few, if any, states appear to have profited by the earlier experiences of sister states, but each in turn lived through all the successive stages of railroad civilization from the stone age up—or up to the stone age, if, as has been asserted, this term characterizes the status of present railroad legislation. Each state—excepting a few of those in the West—had its crops of railroad charters, and as the promoters moved westward from the Atlantic toward the Pacific, the charters were generally more loosely constructed through the omission of the more detailed, explicit, and often restrictive sections. Not a few charters were granted containing only from four to a dozen sections, while the best eastern charters contain from twenty or twenty-five to forty or more. If the states of the Northwest, for instance, had heeded the lessons of New York or Massachusetts, it is probable that the railroad history of this country would have been different from what it is in many respects. In recent times Japan, in her railroad legislation, has given us an illustration of what one state may learn from other states or countries.

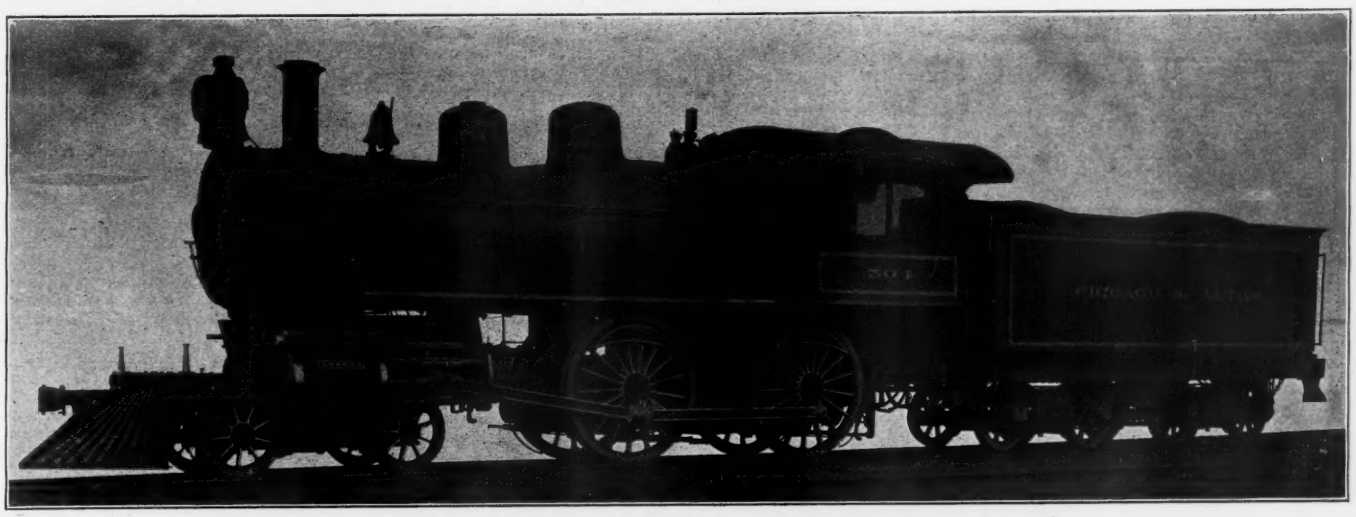
This suggests the splendid English custom, for illustrations of which we may turn to the railroad laws of India, Canada and the Australian Colonies, of carefully defining in the act itself the terms employed therein. American charters and general laws are full of terms which require definition in order to be understood. Instances could be cited where charters specify judicial or other officers for the performance of certain duties, which have neither legal nor constitutional existence in the state which granted the charters. This is only one of the many ways in which the greatest carelessness in the passing of railroad charters by our legislatures is revealed. Yet, it would be rash to conclude that carelessness in granting charters necessarily resulted in the construction and operation of inferior railroads, or in abuses characteristic of the business; although it is difficult to see why charters granted by the same legislature during the same week, for similar railroads, should contain widely diverse or antagonistic clauses.

An analysis of the contents of railroad charters of the various states shows substantial uniformity in corporate powers, provisions relating to appropriation and to the size of shares, and certain police regulations. But here uniformity usually ceases. Of course, differences due to differences in the enterprises themselves ought to exist in the charters and laws, but it is one of the striking features of our railroad history that both special and general laws may vary widely even though they apply to railroads constructed and operated under essentially similar if not identical conditions. In the charters, the number of commissioners and directors appears to be fixed by chance. With few exceptions, the capital stock bears no relation to the size of the undertaking. The power to borrow money and to increase stock is usually guarded only in the vaguest and most general terms. The name of the company frequently contains the best available description of the route. Junctions, branches and extensions are rarely well provided for. Provisions on rates are contained in only a small proportion of the earlier charters and generally wanting in those of later period. Annual reports embracing from eight to one hundred and fifty or more items are prescribed without adequate provisions for carrying out the intention of the law. With illustrations of this kind one might continue almost indefinitely. To present what the charters do not contain and wherein they differ would involve the writing of a treatise on railroad legislation.

An analysis of our general laws reveals a similar state of affairs. We find there omissions, differences, inconsistencies essentially identical with those in the charters. The laws of a few of the states are relatively complete. The laws of others contain numerous admirable provisions. But it is probably true that the laws of all the states taken collectively do not contain all the provisions essential for a complete railroad law of to-day. In three-fourths of the states reports are called for which ought to furnish information sufficient for intelligent control; yet who, by the terms of the charter, has power to verify these reports? Charters and laws require crossings to be left in good condition. During the earlier epochs, charters designated no one with power to enforce compliance with this provision, nor do the later charters generally do so. The commission laws have, however, in some instances remedied this defect. Here and there provisions relating to sinking funds and other wholesome financial arrangements appear in the charters, but their execution is left to the good will of the promoters. And when we recall that the same men frequently figured in a number of different projects involving, perhaps, millions of dollars, although the public had no asurance that these men could pay even their tailors promptly, the defects of such charters and laws are apparent.

It will add to whatever value this bird's eye view of railroad charters may possess to consider a few of the chief characteristics of foreign railroad charters. Inasmuch as charters and laws of more than a dozen

*A paper read at the Ithaca meeting of the American Economic Association.



Brooks Eight-Wheel Passenger Locomotive—Chicago & Alton Railroad.

countries reflect prominent features of foreign legislation, we may venture the statement that railroad charters the world over have been constructed on the same plan. Their skeletons are everywhere alike. Taking their earliest shape in the turnpike and canal legislation of England before the era of railroads had come, their first forms were generally preserved in both European and American states as well as in Japan. Various archaic features contained in the charters of to-day amply support this statement.

One of the commonest and best known among these survivals is the reservation, in so many charters of our states and of foreign countries, relating to the use of the railroad track by different and, perhaps, competing transporters. A few American charters distinguish between "toll" and "transportation" charging, say, two cents for toll and three cents for transportation going from north to south, and two cents for toll and one cent for transportation going from south to north. The published legal schedules of France, to-day, separate the "right of toll" from the "price of transportation," so that a shipper who pays, say, a total of five francs freight charges, meets in that single payment two charges separately listed in the schedule, but practically constituting a single charge. The droit de page represents the returns to the capital employed in construction and maintenance, while the prix de transport represents the remuneration of the rolling stock. This distinction in French law is theoretical, of course, and not observed by the public. Were several transporters to use the same track, it would doubtless have practical significance.

The declaration of public utility, legally required in the early laws of a number of our states before a charter could be granted, is also retained in the French railroad code of the present time. A considerable number of the earlier American charters contained preambles, a custom imitated in England and preserved both in its original and modified forms in other countries. The downfall, in America, of the custom of embodying a preamble in a railroad charter removed the last vestige of restraint and was contemporaneous with the indiscriminate granting of charters by our legislatures. The preamble usually set forth the reasons why the project under consideration should be promoted, and upon the validity of the statements made in the same the charter was granted. The protracted parliamentary debates on the Liverpool-Manchester railroad bill centered about the preamble. In only a few of our states does the law require deliberations and hearings of a preliminary nature before a full charter is granted. In this lies one of the most serious defects of American railroad charters—absence of provisions to guard against the chartering and construction of useless and harmful railroads, which has repeatedly been discussed by men interested in railroad affairs in all parts of the country. Something more comprehensive is needed than a bare provision prohibiting the building of parallel or competing lines—ridiculously defined in a number of charters and laws—within a specified term of years, found in many charters and nearly all the general laws of the states. Is it not possible that the practices prevailing in many foreign countries, requiring certain preliminary proceedings before a complete charter can be granted, may be of value to us?

Japan seems to have embodied the results of foreign experience in a recent law with such elaboration as to deserve a moment's attention. According to Japanese law the railroad franchise is separated into three distinct parts, the first of which may be completely separated from the two following. These three parts can be indicated by the terms preliminary, construction and operating charters. The preliminary charter is granted on the basis of a certain estimate which the franchise seekers must submit to the public authorities. It authorizes the projectors to make the necessary surveys and detailed estimates of costs upon the approval of which a permanent charter may be granted. After the road has been constructed, equipped and duly inspected, an operating or business charter completes the granting of the franchise. Without attempting to pass final judgment upon the Japanese scheme, is it not possible that the principles underlying the same may have some value for us? It would probably do away with much of the secrecy and underhanded work which so often accompanies the granting of charters in this country. Every step could in this manner be made public. The choice of a route, the character of the road, and the concessions made to the state could be thrown open to competitive companies, and a permanent charter granted to that organization which should offer to the public authorities the most advantageous conditions; and so on.

The preliminary charter under such or a similar system would take the place of that section of the old charters which empowers the company to enter upon lands for the purpose of making surveys and estimates. An indefinite number of competing persons and companies might secure this privilege, although in case of mere extensions of existing lines the situation would probably in many cases exclude all companies except the one in possession of the field. But there are many sections of our country in which the network of railroads is still so far from complete that a better system of granting charters may be of great service in the future. The preliminary charter would accomplish much more than the old preamble could ever effect because of the complete separation of the preliminary from the permanent grant of the franchise, which, under the old system, were accepted or rejected together. Before the construction charter could be issued, the public authorities would be in possession of one or more estimates of costs and probable income from traffic, together with the obligations which the respective companies are willing to undertake in behalf of the state. There could be no blind play with respect to the route, for this would have to be described, mile for mile, from one terminus to the other. Complete maps and profiles would be publicly exhibited, and all the interests affected given an opportunity to be heard. Existing railways would be protected because no permanent charter could be granted until the usefulness of the projected road had been demonstrated and its influence upon existing industries carefully considered. Having before them accurate estimates of costs, the amount of the capital stock could be intelligently fixed by both company and the public authorities. The hasty and feverish manner in which charters have so often been granted in the past could no longer prevail, to the incalculable benefit of both the railroads and the public. The permanent charter would finally prescribe the organization of the company, route, amount of capital stock, and other individual and local matters which cannot prudently be incorporated in a uniform general law, which, together with the special charter, would constitute the complete railway franchise.

Hand in hand with the suggested revision of our railroad charters and the enactment of uniform general laws, must go a thorough recasting and unification of our present almost indescribably chaotic commission laws; if, indeed, these have not already been included in what has been said with respect to general railroad laws. The writer does not forget that some of our laws, those of Massachusetts and of several other states, for instance, have already reached a high level of advancement, and if the railroad legislation of all our states—especially that relating to the granting of charters—could be brought up to the Massachusetts level, a long step forward would have been taken; but if any one doubts the justification of so emphatic an expression as "indescribably chaotic" let him spread out before his eyes a comparative exhibit of these laws and all uncertainty will be removed.

Another feature of foreign charters is the recognition in railroads of different degrees of importance to the public, and an acknowledgment of these differences in the provisions of the charters and in the laws applying to them. Taking the general laws and charters of the United States as a whole, it may be asserted that the law places relatively unimportant local railroads on the same footing with those which are most important. The charter of a trunk line may be an exact duplicate of that under which a line connecting several villages is operated. It is needless to add that a few exceptions, such as provisions relating to taxation, must be made. France, Italy, Switzerland, the countries of Germany, and England, even, recognize in charters and laws a rational classification of railroads based upon their relative degrees of importance. Would it not be profitable for American law makers to consider the advisability of adopting one type of charters for local (perhaps intra-state) railways and another type for those which go beyond the limits of one state? Would not a clearly defined division of functions in this respect between the federal and state governments lead to beneficial results? Could not the much needed uniformity among the several states be encouraged in some such way as this? Why should not a railroad be authorized to do business under a local charter until it becomes a part of a greater system, and then cause it to comply with the provisions of a federal charter? The Inter-State Commerce Law seems to suggest such a line of action.

The present lack of uniformity in both charters and general laws of the various states must be irritating and exasperating to those railroads which make an attempt to comply with their provisions. What man of sound mind would expect to maintain his health and bodily vigor if he were to subject different parts of his body to different and opposite methods of treatment at the same time? Yet this is exactly what has been done and is being done to our railroads through our checkered and many colored charters and laws. To those who believe that the time may come when public ownership will be a question of the day, this lack of uniformity and harmony in charters and laws has great practical significance, for it is difficult to see how an elaborate practical program can even be made out, not to speak of its execution, before substantial uniformity has been brought about. Our national and state commissions, both individually and in convention, have repeatedly emphasized the urgent need of uniformity in accounts, only the beginning traces of which are found in the charters and laws of several states. However, it is possible that practice has outstripped law in this respect, and that greater uniformity exists than is indicated in an analysis of legislation, special and general.

Another feature which obtrudes itself upon one's attention in an analysis of railroad charters and laws, and which is largely the result of the chaotic condition of legislative enactments, is the lack of adequate administrative machinery. What if a charter is good? What if the general incorporation laws are strong? Who has the efficient power necessary to enforce compliance on part of the one against the ninety and nine railroads that, perchance, would voluntarily meet all reasonable requirements? It is said that in railroad affairs the weakest may rule the strongest. One looks in vain for charter provisions which will make this impossible. It seems that legislators were loath to place discretionary powers into the hands of administrators, and as a result we have that long list of hard and rigid provisions relating to long and short hauls, pools, consolidations, rates, etc. In addition, we find similar provisions, more or less comprehensive in their scope, in the constitutions of three-fourths of the states, while in a few states the constitution contains practically all the railroad legislation there is. Considering the nature of the railroad business on the one hand, and the difficulty of amending constitutions on the other, is not the embodiment of railroad clauses, beyond a few simple and general principles, in our state constitutions, of doubtful utility? This lack of elasticity is a serious defect in our charters and laws, and is, perhaps, partly if not entirely the result of inadequate administrative machinery in which proper adaptive elements might have been incorporated.

Another lesson which foreign charters and laws may teach us lies in the protection of public interests and the representation of social and economic interests in the conduct of railroads. With the exception of England, all the leading foreign countries provide ways and means by which every industry, trade or profession may regularly exert influence in its own behalf. Prussia, Switzerland and Japan provide for a system of advisory councils by law, and other countries have established similar representative organs through the agency of administrative orders. The existence of such councils in this country, reflecting the opinions and interests of all classes, would probably do much to overcome that feeling of helplessness on the part of an aggrieved public which one is likely to feel in a study of American railroad charters. Both the railroad and the public would be the gainers, because each would thus learn to understand the other through regularly constituted channels.

This paper does not primarily concern itself with the actual workings of the charters and laws, upon the analysis of which the generalizations here advanced rest. Given identical laws in different states and countries, but different administrative bodies and methods, the practical effects may vary widely. French courts, for instance, have declared a crated plow baggage, and have absolved several merchants, who had been caught in a slight wreck and who had ordered a special train in order to reach on time a fair for which they were bound, from payment for this train. In the United States, courts refuse even the statements of facts made by our commissions. It is clear that the same laws in France and in the United States might bring about varying results.

The concluding paragraph of this paper may well be devoted to expressions of opinion of railroad officials formulated in letters written by them. Communications received from over one hundred, relating to railroad charters, show practical unanimity in the demand for uniformity. A tabulated analysis of railroad charters and laws shows at a glance the utter lack of agreement between them, and it is a matter of satisfaction to be able to bring to the support of a student's conclusions the combined authority of leading railroad men. One official suggests that the Federal government grant charters, and that all applications for charters be referred to a non-political commission for examination. Another asserts that stability and highest efficiency can never be attained until all the great railroads of the country have been placed under substantially a single organization, guided by one broad, general policy. Then, he thinks, discriminations and kindred evils will cease to be a necessity of the situation. Several emphasize the necessity of reorganizing railroads under uniform general laws and of expressing all the provisions of the franchise clearly, and making them equally binding upon the companies and the public. Every point of importance should be fixed in the charter, and minimum as well as maximum rates should be established. Others emphasize the importance of prescribing by law all the physical conditions of a railroad, and many deprecate the absence of legal provisions against the construction of railroads for purposes of blackmail and speculation. A few point out the absence of statutes making legal and constitutional provisions effective. In short, aside from isolated cases, no opinions were expressed and no lines of action indicated by the railroad men who touched upon the subject at all in their letters, which are not in substantial harmony with the conclusions suggested by an independent, objective analysis of existing railroad charters and general laws.

TECHNICAL.

Manufacturing and Business.

F. C. Smink, heretofore Treasurer and General Manager of the Reading Iron Co., has been elected Vice-President and General Manager. George B. Harris, son of President Harris, of the Philadelphia & Reading, has been elected Treasurer.

Thomas A. Orr on Jan. 2 became a member of the firm of Robinson & Orr, makers of iron and steel, Pittsburgh, Pa. The partners now are J. F. Robinson, Robert A. Orr, and Thomas A. Orr.

The Lyman Pneumatic Signal Co. has been incorporated in New Jersey with a paid-up capital of $41,500. The corporators are Henry C. Lyman, Sherburne, N. Y.; L. D. Brainerd, of Rochester, N. Y.; George P. Hemstrul, of Hastings, N. Y.; H. H. Shepard, of New Berlin, N. Y., and C. Rowland Monroe, of Newark.

The Standard Scale & Supply Co. of Pittsburgh has received an order for 18 1,600-bu. hopper scales, equivalent to 18 scales of 50 tons capacity each, for the large new terminal elevator of the Great Northern at West Superior, Wis. They will be equipped with Reed recording attachments which are used by a number of railroads, blast furnaces and manufacturing plants. Within a short time this company has received orders for large track scales from the Baltimore & Ohio, Louisville & Nashville, Wisconsin Central and several other roads.

Iron and Steel.

The stockholders of the Lackawanna Iron & Steel Company at Scranton, Pa., Dec. 29, voted to increase the capital stock from $3,750,000 to $25,000,000.

The Mechanical Conventions.

The conventions of the Master Car Builders' and Master Mechanics' associations will be held this year at the Grand Union Hotel, at Saratoga, June 18 to the 23d. The M. C. B. Convention will open Monday, June 18, and last two days, while the opening session of the M. M. Convention will be Thursday, June 21, the Convention holding until the end of the week. With this arrangement the work of both Conventions will be done within six days.

The Drainage Channel.

Water was turned into the Chicago drainage channel on Tuesday morning. The trustees of the Sanitary District acted without the consent of the State Commission. The controlling works at Lockport will probably be used to hold the water back from Desplaines River until the permission of the State authorities is granted.

Chicago & Northwestern Shops, Chicago.

The improvements at the West Fortieth St. shops of the Chicago & Northwestern are expected to be completed early in the spring. As outlined in our issue of April 7, these include an annex to and a gallery around the present erecting shop, a new boiler shop, an extension of the present tank shop and a new central power and lighting and heating plant. All the shops will be equipped so as to be electrically driven from the central station, which will replace a number of small individual steam plants. There are now being installed two 250-h. p. Ball vertical cross compound engines, each engine being direct-connected to two 75 k. w. General Electric generators. There is also being added a small unit, consisting of one 60-h. p. Ball engine direct-connected to two 20-k. w. dynamos. The motors throughout the plant will be of the General Electric make and the wiring throughout will be on the Edison three-wire system, providing 110 volts for the lights and 220 volts for the motors. The installation of the electrical machinery is being done by the Construction Department of the Chicago Edison Company.

THE SCRAP HEAP.

Notes.

The penalty imposed on Mr. Polk by the Texas State Railroad Commissioners for contempt (case reported in the Railroad Gazette of Dec. 22), was a fine of $50.

Some of the employees of the Pennsylvania who are past 70 years of age are unwilling to retire on a pension, and it is said that one of these remonstrants is a baggageman on the New York and Chicago Limited, running between Philadelphia and Pittsburgh, who is 91 years old.

Baltimore papers report that the employees of the Western Maryland have had their pay increased 5 per cent. This, with a similar increase in 1898, restores what was taken off in 1893. The Cleveland City (Street) Railway has distributed $5,000 among its employees in Christmas gifts.

Press dispatches from St. Paul report that the Great Northern has decided to invite conductors and enginemen to become stockholders in the road. It is proposed to issue new stock equal to 10 per cent. of the amount now outstanding and to offer this to the employes at par. The stock is now selling at a large premium.

The Coal Trade Journal estimates that the amount of anthracite coal produced in 1899 was 47,274,048 tons, as compared with about 42 millions in each of the two preceding years. The amount of bituminous coal mined in the United States during the year is estimated at nearly 200 million net tons. On this coal there has been a general advance of about 50 cents in price during the year.

A press dispatch from Chicago states that on export grain billed from the Mississippi River an advance of three cents per 100 lbs. was made on January 1 to all Atlantic seaboard points.

Passenger rates between Chicago and St. Paul are now said to be in good condition, all lines having agreed to maintain the published rates until Feb. 1. The executive officers of the roads in the Southeastern Mississippi Valley Traffic Association have adopted the changes in classification (which advance the rates on many commodities) recently reported by the freight traffic officers. The cutting of tourist fares from Boston to California continues and it is said that this causes considerable uneasiness among passenger men concerning all transcontinental rates. Chicago ticket brokers are said to be making rates corresponding to those made at Boston. At a meeting of representatives of the Southern Railway and of the Seaboard Air Line, held last week, it is said that the two roads agreed together to maintain their present tariffs during the current year. It is announced that the controlling interest in both the Hocking Valley and the Toledo & Ohio Central roads has been acquired by interests friendly to each other and that the severe competition in rates between these two lines, which has prevailed in the past year, will now come to an end.

Chesapeake & Ohio Emergency Hospital.

The Chesapeake & Ohio has bought the old Buffington residence in Huntington, W. Va., and will remodel it as a hospital to give accommodation to a few patients, particularly emergency cases. The company's general hospital is located at Clifton Forge, Va. Mr. Stuart, architect at Huntington, will remodel the present building, adapting it to hospital purposes.

A Judicial Decision on the Fourth Section.

The United States Circuit Court for the Southern District of Alabama, in a case against the Atlanta & West Point Railroad, involving the fourth section of the act to regulate commerce—the long and short haul law—has sustained the Interstate Commerce Commission; and this decision is based on the presumption that "the conclusions of the Commission [that the law had been violated] are well founded and correct." Such conclusions will not be set aside unless error clearly appears. From New Orleans to Lagrange, some distance short of Atlanta, the rate was as high as the rate to Atlanta and back to Lagrange. The court does not commit itself to the proposition that the rate from New Orleans to Lagrange is unreasonable, intrinsically or in comparison with the rate to Atlanta. It is not prepared to assert that transportation between New Orleans and Lagrange is done under the same conditions and circumstances as transportation between New Orleans and Atlanta. But the findings of fact by the Commission are made by law prima facie evidence of the matters therein stated, "and the conclusions of the Commission based upon such findings are presumed to be well founded and correct, and they will not be set aside unless error clearly appears." It was held that the record does not clearly show that the conclusions of the Commission are not in accord with the law and the evidence, wherefore the court ordered the injunction asked for by the petitioner in accordance with the findings of the Commission.

Track Elevation Proposed in Allegheny, Pa.

The city of Allegheny has received a new proposition from the Pittsburgh, Fort Wayne & Chicago, in which the company proposes to elevate portions of its tracks from the Ft. Wayne bridge over the Allegheny River. The railroad company practically agrees to bear the entire cost of the change. Reports state that the elevation of the tracks is necessitated by a new bridge being required over the Allegheny River to reach the new union station in Pittsburgh, on which work will soon be begun.

The Northwestern Elevated, Chicago.

The structure of this road and its connection with the Union Elevated Loop were completed Dec. 31, so that trains could run over the road to comply with the franchise which expired that day. But a number of the stations have not been completed and it is not expected that a schedule of trains can be arranged or regular service established for some time to come. Notices were posted at stations along the road on Dec. 29 that until further notice the train service would be limited to passengers from Lincoln Ave. north, and that only the Lincoln and Wilson Ave. and Buena Park stations would be opened at present. Work on the other stations and platforms and on the switches and signals will be pushed as rapidly as possible. On Jan. 2, by order of the Commissioner of Public Works, trains were stopped and all work brought to an end on the ground that the structure was unsafe.

Chicago Drainage Channel.

The Sanitary District Trustees and the Commissioners of the Illinois & Michigan Canal have reached an agreement as to how the water supply of the upper section of the canal shall be kept up after the city pumps at Bridgeport are stopped. The main features of this controversy were given in our issue of December 15. The agreement, made December 21, provides that the Sanitary District shall maintain the present flow of water in the canal for four months and after that time the flow shall be sufficient simply to maintain a depth of 6 ft. for purposes of navigation; the four months' period being held sufficient for those now using the water power at Joliet to make other arrangements for power. It is estimated that between 6,000 and 12,000 cu. ft. of water a minute is sufficient for purposes of navigation only. The Sanitary District is left free to furnish this water either by pumping, as is now done, by the city, or by building a feeder on the summit level and deepening the canal above the first lock. Two suits brought by the Canal Commissioners to enjoin the Sanitary District from opening the Drainage Channel have been redrawn in view of this agreement.

Technical Schools.

Yale University.—Messrs. Carriere & Hastings are the architects for the memorial buildings to be put up by the graduates of Yale University for the Bicentennial celebration in 1901. An auditorium to seat about three thousand people, and a large dining hall will first be built. These buildings will each be about 100 ft. x 150 ft. in ground plan and about 60 ft. high, and will be connected. The approximate cost will probably be $500,000, although the materials and details of construction have not yet been determined.

Cooper Union.—Mr. Andrew Carnegie has given $300,000 to enable the trustees of Cooper Union, New York, to established a day school similar to the night schools, which will give practical instruction in practical mechanics. No attempt will be made to teach a trade, but rather to teach the use of tools, so that those who leave these schools may enter employment which will pay them from $10 to $15 a week. It is intimated that $200,000 will be added to this sum by Messrs. Edward Cooper and Abram S. Hewitt. The new school will provide for the instruction of 500 students. The income on the $500,000 will be $25,000, and this will be $50 a year for each of the 500 scholars. Plans will be made for opening the school next autumn.

Massachusetts Institute of Technology.—President J. M. Crafts of the Massachusetts Institute of Technology has resigned, the resignation to take effect at the end of the present school year. President Crafts desires to have more freedom for the pursuit of experimental science than is now possible. He was Acting President after the death of Gen. Walker and was elected President in 1897.

LOCOMOTIVE BUILDING.

The Pacific & Idaho Northern (now building) will, it is said, order six locomotives.

It is stated that the Philadelphia & Reading has ordered 30 locomotives from the Baldwin Locomotive Works.

The Oregon Short Line wants 10 locomotives, but the order is being held up for the present on account of prices.

On Dec. 8 we noted that the Colorado & Southern would want locomotives. We now understand that about 10 will be ordered.

The five heavy passenger locomotives ordered by the Chicago & Eastern Illinois, as noted Dec. 22, will be built by the Pittsburgh Locomotive & Car Works.

The Colorado Fuel & Iron Co., of Denver, has recently ordered five locomotives from the Baldwin Locomotive Works. These locomotives are to be Baldwin standard engines, the buyers not specifying either dimensions or material.

The specifications for the eight consolidation engines for the Rio Grande Western recently ordered from the Richmond Locomotive & Machine Works and described in our issue of Dec. 15 call for Westinghouse air brakes, Midvale hammered steel axles, Monarch brake beams, Ross-Mehan brake shoes on drivers, Buck headlights, Ohio injectors, Jerome piston and valve rod packings, Ashton safety valves, Leach sanding devices, Nathan lubricators, French springs and Latrobe driving wheel tires.

In our issue of Dec. 15 we gave the principal dimensions of the 41 engines ordered by the Southern from the Richmond Locomotive & Machine Works. They are for May, June and July, 1900, delivery. The specifications call for Carbon steel for boilers and fireboxes (excepting for the consolidation engines where simply "steel" is specified), Westinghouse air brakes, open-hearth steel axles, compressed air bell ringers, Sterlingworth brake beams, Ross-Meehan brake shoes, M. C. B. couplers, electric headlights (excepting the consolidation engines), Monitor injectors, Coale muffled safety valves, Leach sanding devices, Nathan 1899 lubricators, National springs, Crosby thermostatic steam gages, steam heat equipment (excepting the consolidation engines), Latrobe driving wheel and Taylor truck and tender wheel tires. Four of the passenger and six consolidation locomotives are for the Alabama Great Southern.

CAR BUILDING.

It is stated that the Fitchburg is preparing to build 125 box and 100 flat cars.

The Pullman Co. is building four sleeping cars for the Chicago, Milwaukee & St. Paul.

It is reported that the Pacific & Idaho Northern, now building, will want about 400 cars.

We are informed that the Allegheny Valley is receiving bids on 300 coal and 100 box cars.

The Barney & Smith Car Co. is building 200 drop bottom coal cars of 80,000 lbs. capacity for the Canadian Pacific.

We understand that the Western New York & Pennsylvania has ordered 12 passenger cars from the Jackson & Sharp Co.

It is reported that the Grand Trunk is in the market for 2,000 more cars for use east of Toronto. We have no official information.

We are officially informed that the Minneapolis, St. Paul & Sault Ste. Marie is not in the market for passenger cars as stated by a contemporary last week.

Bids are being asked by the management of the Chicago, Lake Shore & Eastern on 50 coal cars of 80,000 lbs. capacity. The cars are to be used by parties whose names are not given.

The Pressed Steel Car Co. has received an order for 50 steel ore cars of 100,000 lbs. capacity from the Algoma Central, a railroad now building in Ontario. The cars will be similar in design to those recently built for the Great Northern and Lake Superior & Ishpeming roads.

The Chicago & Northwestern has recently received from the Pullman Co. and put in service between Chicago and St. Paul a new dining car unusually elegant in its finish and furnishings. The car is larger than the ordinary dining car, the extra space being used for larger tables. The interior is finished in mahogany, the carpet and decorations being in light green. Each table has a candelabra of electric lights.

The order for cars for passenger service for the Oregon Railway & Navigation Co. and Oregon Short Line has been placed with the Pullman Co., as stated Dec. 22. Ten coaches, two dining cars and three chair cars will be built for the former, and seven coaches, three dining cars, two postal cars, three baggage cars and three chair cars for the latter. The order for freight cars for the Oregon Short Line has been temporarily laid aside on account of prices.

The orders for cars recently placed by the Southern were divided as follows: The Pullman Co., 12 coaches and six combination passenger and baggage cars for July, 1900, delivery, and 12 baggage and express cars for August, 1900, delivery; American Car & Foundry Co., 500 ventilated box for the Southern and 150 box cars of the same dimensions for the Alabama Great Southern, for delivery at the rate of 15 a day, beginning Jan. 15, 1900; 100 stock, 200 coke (with the same framing as the stock cars, without roof, and with two extra half doors on each side), and 300 plain gondola cars for delivery 15 a day, to follow the box cars; and Southern Car & Foundry Co., 650 double hopper coal cars, to be delivered 15 a day, beginning about Jan. 23. One hundred and fifty of the last-named cars are for the Alabama Great Southern. The passenger coaches will weigh 79,510 lbs. and measure 57 ft. long and 9 ft. 8½ in. wide over outside sills and 10 ft. 6½ in. high from bottom sill to top of roof; the combination passenger and baggage cars will weigh 91,700 lbs., measure 65 ft. long and have the same width and height as the passenger coaches; the baggage and express cars will weigh 89,450 lbs. and measure 61 ft. long, 9 ft. 8½ in. wide and 10 ft. 5¾ in. high. The specifications call for open hearth steel axles, Sterlingworth brake beams, Diamond S brake shoes, Westinghouse air brakes, Ajax brasses, three-stem Buhoup couplers, Gold steam heating system, Harrison dust guards, cast iron journal boxes with pressed steel lids, Pintsch gas, Standard steel platforms, National springs and Taylor steel tired wheels. The combination passenger and baggage coaches will have Forsyth curtain fixtures and Pantasote curtains. The freight cars will all be of 60,000 lbs. capacity. The ventilated box cars will weigh 35,600 lbs. and measure 40 ft. long, 8 ft. 2¼ in. wide inside and 7 ft. 1¾ in. high from floor to ceiling; the stock cars will measure 38 ft. long, 8 ft. 2 in. wide and 7 ft. 2¼ in. high from floor to bottom of car line; the plain gondolas

will weigh 29,300 lbs. and measure 34 ft. long, 8 ft. 4½ in. wide inside and 40 in. high from floor; the double hopper cars will weigh 30,300 lbs. and measure 25 ft. 7¼ in. long, 7 ft. 7 in. wide inside and 6 ft. high above sills. All the cars will be equipped with open-hearth steel axles, Sterlingworth brake beams, cast iron brake shoes, Westinghouse brakes, Ajax brasses, Hein couplers, Butler draft rigging, Harrison dust guards, cast iron journal boxes, with pressed steel lids, National springs and Southern standard channel bar trucks with frictionless roller side bearings. The double hopper cars will have Fox body and wooden truck bolsters; the other freight cars will have Simplex body and wooden truck bolsters. The ventilated box cars will have Security doors with Dayton fastenings and Chicago (plain) roofs.

BRIDGE BUILDING.

BENNINGTON, ONT.—Three steel bridges are to be built by the county during 1900. E. S. Sutherland can give information.

BRISTOL, CONN.—The Selectmen propose to build a new two-span bridge across the Pequabuck River. No estimates of the cost have as yet been made. D. J. Hofferman, Borough Clerk.

COLDWATER, MICH.—I. D. Miner, County Surveyor, informs us that he has recommended several iron bridges across the Coldwater River and other streams.

EVERETT, WASH.—The County Auditor has been instructed to call for bids for a bridge on the Snohomish and Stanwood roads, according to plans on file at the Auditor's office.

FORT DODGE, IA.—The City Council has passed a resolution requiring a bridge built on Third St. over the tracks of the M. & St. L. RR., also over the C., R. I. & P.

KERNEY, NEB.—The Buffalo County Board of Supervisors will receive bids until Jan. 10 for repairs to the Platte River bridge.

KNOBNOSTER, MO.—The Road and Bridge Committee of the County Court will receive bids at Warrensburg, Feb. 8, for seven iron and combination highway bridges, from 80 to 20 ft. long. Contracts for 25 other spans of various lengths are soon to be let. Geo. T. Gallaher may be addressed.

MACON, GA.—The bridge proposed across the Ocmulgee River at Fifth St. is to cost $37,000. The Councils have made an appropriation and work will probably be begun early in the spring.

McKEESPORT, PA.—The Union Traction Co. of Pittsburgh will need a viaduct across Fifth Ave., from Highland Ave., McKeesport, on the extension to Wilmerding.

NEW YORK, N. Y.—The Board of Aldermen has authorized the proposed bridge over Newtown Creek, at Grand St., Brooklyn, at a cost of $200,000.

The Board of Aldermen Dec. 30 appropriated $1,000,000 for the proposed bridge from Pike St. to Brooklyn.

ONEMEE, ONT.—The Township Council has decided to build a steel bridge over Pigeon River.

OSKALOOSA, IA.—Bids are wanted on Jan. 10, according to report, by J. B. Cruzen, Auditor of Mahaska County, for bridges to be built during 1900.

PAPILLION, NEB.—The Commissioners of Sarpey County will receive bids until Jan. 8 for bridges to be built in 1900. J. R. Wilson, County Clerk.

PITTSBURGH, PA.—Reports state that a new bridge will replace the old Fort Wayne bridge over the Allegheny River in connection with the plans for the new union station by the Pennsylvania, mentioned under Other Structures.

In the estimates of the Department of Public Works for enginering projects during 1900 is included $27,925 for bridges.

PORTAGE DU FORT, QUE.—The bridge proposed over the Ottawa River at this point will cost about $30,000. The Quebec and Ontario Governments will aid.

READING, PA.—Reports state that the Philadelphia & Reading has had drawings made for a steel bridge at Front St., estimated to cost $10,000.

REDWOOD CITY, CAL.—Sealed bids will be received Jan. 15 for a bridge over Pilarcitos Creek, Spanishtown, San Mateo County. M. H. Thompson, County Clerk.

ST. CLAIR, MICH.—Application has been made by the River St. Clair Ry. & Bridge Terminal Co. for concessions toward building the bridge over the St. Clair River from Moore Township, Lambton County, Ont.

SPRINGFIELD, MASS.—Mace Moulton, Consulting Engineer, has made a preliminary report to the City Council on the proposed bridge across the Connecticut River to replace the toll bridge and to cross the Boston & Albany tracks. The approximate cost is $135,000.

STOCKTON, CAL.—A proposition to bond the city for $400,000 for bridges and other improvements will soon be submitted to the voters.

WATERVILLE, ME.—The proposed suspension bridge over the Kennebec River is to be at Waterville, Me., and not Connecticut, as incorrectly reported last week.

WAUKEGAN, ILL.—Among the improvements proposed at Fort Sheridan by the Government is a new single span iron bridge over a ravine.

YOUNGSTOWN, O.—The Mahoning County Commissioners have been asked to build a bridge across the Mahoning River near the National Steel Company's plant at a cost of $150,000.

Other Structures.

CAMDEN, N. J.—The Emporium Furnace Co. has been incorporated, with a capital stock of $150,000, to make iron and steel. F. B. Baird, C. R. Baird, S. H. Baird, N. H. Wagner and W. J. Jamison are the incorporators.

CHESTER, PA.—The Chester Steel Casting Co. proposes to build an additional building 60 x 80 ft.

COLUMBIA, PA.—The Susquehanna Iron & Steel Co. will build a new pipe mill at Columbia on which work will soon be begun. Work on a new foundry is already started.

MILWAUKEE, WIS.—It is understood that the Illinois Steel Co. will begin work in the spring at its Milwaukee plant on two new blast furnaces, steel converting works and possibly structural steel mills.

OTTAWA, ONT.—Work will probably not be begun on the new Central Depot by the Canada Atlantic Ry. until next fall, owing to Government Military Stores being located on the proposed site. The Government has received an appropriation from Parliament for a new building and plans are being prepared. The Canada Atlantic will build the central station immediately on the vacation of the site by the Government.

PHILADELPHIA, PA.—The Baltimore & Ohio has let a contract for a double-deck pier 585 x 130 ft., to be built at the foot of Jackson St. and Snyder Ave. It will be built of wood and covered with galvanized iron. We are told that the object of building the structure is to take care of the export and import business of the company. It will be known as the "export pier." Tracks will be laid on both floors.

The Baldwin Locomotive Works has let a contract to Roydhouse, Arey & Co. for the three-story foundry building to be built at Pennsylvania Ave. and Broad St. to Hamilton St. It will be a brick and iron structure 75 x 210 ft.

Two buildings are to be built on the Chestnut Hill branch of the Pennsylvania RR. between Westmoreland and Queen Lane Stations, Philadelphia, for Davis Brothers, to be used as spike mills.

PITTSBURGH, PA.—The Councils on Dec. 26 passed the revised ordinance granting the Pennsylvania RR. certain privileges relative to elevating tracks and building a new union station at Liberty Ave. and Eleventh St. It is said that work will soon be begun. A description of the proposed station and the plans for elevating the tracks were given in the Railroad Gazette Dec. 9, 1898, p. 873.

The Oliver Iron & Steel Co. has a permit from the Building Department for a new steel building on the Monongahela River front from South Tenth to South Twelfth St. The building will cost $15,000, and will be used as a machine shop.

PORT ARTHUR, ONT.—The town officers voted on Dec. 29 to grant a $50,000 subsidy to the Ontario & Rainy River Ry. (Canadian Northern), provided the company builds a through passenger and freight station, a million-bushel elevator, roundhouses and shops. The railroad will be exempt from taxation.

POTTSTOWN, PA.—Willauer & Missimer of Pottstown have a contract for part of the work on the new furnaces for the Warwick Iron & Steel Co.

TYLER, TEX.—The St. Louis Southwestern will build a new machine shop at Tyler, 100 x 150 ft., of brick and iron, and to cost about $20,000. The requisitions have been placed for the material, although it is possible that the contract for building will be let.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see page xii.)

Railway Signaling Club.

A meeting of the Railway Signaling Club will be held Tuesday afternoon, January 9, at the Great Northern Hotel, Chicago. Mr. A. H. Rudd, Signal Engineer of the New York, New Haven & Hartford, will present a paper on the connections of slip and split switches.

Railway Transportation Association.

Secretary G. P. Conard, New York City, gives notice that the winter meeting of the Railway Transportation Association will be held at the Southern Hotel, St. Louis, Mo., on Wednesday, January 17. Reports will be presented by committees on General Transportation Topics; Car Service; Movement of Trains on a Tonnage Basis; Interchange and Distribution (Uniform Card Way-bill), and on Loading Freight Cars to their Full Capacity.

Engineers' Club of Cincinnati.

The twelfth annual meeting of the club was held December 21, in the rooms of the Literary Club, with 25 members present. Dinner was served at 6.30 p. m., and the regular meeting called to order at 8 p. m. Vice-President Punshon in the chair. Officers for the ensuing year were elected as follows: President, Thomas B. Punshon; Vice-President, Wm. C. Jewett; Directors, A. O. Elzner, L. E. Bogen and Alfred Petry; Secretary and Treasurer, J. F. Wilson. Mr. A. O. Elzner read a paper on "The Commercial Value of Art."

American Society of Civil Engineers.

At the meeting of the Board of Directors on Jan. 2, Rear Admiral George W. Melville, U. S. N., and Mr. Thomas F. Rowland were elected Honorary Members of the Society. Some particulars of the careers of these gentlemen will be found in the Personal column.

At the regular meeting of Wednesday, January 3d, a paper by Allen Hazen, Assoc. M. Am. Soc. C. E., entitled "The Albany Water Filtration Plant," was presented by the author and illustrated with lantern slides. This paper was printed in the Proceedings for November, 1899.

Northwestern Electrical Association.

The eighth annual meeting of this Association will be held at the Hotel Pfister, Milwaukee, Wis., Jan. 17 and 18. About 150 members and visitors are expected and preparations are being made for an interesting and useful meeing. A good program has been arranged for, including papers by Profs. Jackson and Richter of Wisconsin, Prof. Shepardson of Minnesota and several others. Officers will be elected and changes in the by-laws considered. Reduced rates have been secured from the railroads. Mr. James Wolff, 320 Dearborn St., Chicago, Chairman of the Transportation Committee, may be addressed in regard to railroad rates, reservations, etc.

Western Society of Engineers.

On Tuesday evening, Jan. 2, the thirtieth annual meeting and dinner of the Western Society of Engineers was held at the Grand Pacific Hotel, Chicago. This dinner was in honor of the close of the 30th year of the Society. Sixteen of the original members of the organization who used to meet in 1869 were invited to be present, and the talk and after dinner speeches were made especially interesting by the reminiscences of the old times.

The election of officers for the ensuing year resulted as follows: President, Ambrose V. Powell; First Vice-President, E. J. Blake; Second Vice-President, W. H. Finley; Treasurer, Ralph Modjeski; Trustee, B. J. Arnold.

The Engineers' Club of Philadelphia.

A business meeting of the Club will be held on Saturday, January 6, 1900, at 8 o'clock p. m. The subject of the paper was not received in time for insertion in this notice, but will be posted at the Club House.

The stated meeting held December 16 was called to order by President Francis Schumann, at 8.20 p. m. There were 74 members and visitors present.

Mr. Chas. J. Dougherty presented the paper of the evening on "Annealing Armor Plates in the Construction of War-ships," in which he described the electrical process of annealing Harveyized steel plates in places where they are to be afterward drilled for bolts or other fastenings. By this method an electric current of low pressure and large volume is passed through the plate between two large copper terminals placed against it on opposite sides of the part to be annealed. The electric generator and transformer for furnishing the current and the apparatus used in applying it to the steel plate were fully described, with the aid of illustrations projected by the electric lantern. At the conclusion of the paper a general discussion upon its subject was participated in by Messrs. W. C. L. Eglin, Francis Schumann, William Easby, Carl Hering, Edgar Marburg, John C. Trautwine, Jr., Edwin F. Miller and others.

American Society of Mechanical Engineers.

The meeting under the direction of the Junior members was held at the Society house in New York on Tuesday evening of this week. The subject of the evening was

"The Diesel Motor."

Col. E. D. Meier, Chief Engineer of the Diesel Motor Co., spoke informally on the development of the motor, touching on many points of theoretical interest, and concluded with the explanation of some diagrams thrown on the screen. After the address there was an informal discussion, lasting about 20 minutes, in which many of the important features in design were freely spoken of. As doubtless known to the reader, this gas engine differs from all others thus far built in that there is no actual explosion, but the fuel is sprayed into the cylinder and burned during the entire stroke; but the engine works on the Otto cycle. The theoretical efficiency resulting from this burning of the fuel is very large, approaching the ideal thermodynamic efficiency of such an engine. By avoiding the explosion at the beginning of the stroke, the chief gain is effected by the nearly uniform pressure during the entire stroke, whereas, in the usual type of gas engines, the greatest pressure comes at the beginning of the stroke, just at a time when the crank is at a position when it cannot receive the full benefit of the great pressure. Diesel motors are now being built in Newark, and one will be completed in a short time. There is also one engine now running at St. Louis and another at Worcester, Mass. Probably no engines less than 30 h. p. will be built: that is, 10 h. p. in each of the three cylinders. The largest now running develops 60 h. p., but Col. Meier stated that the company was prepared to take contracts for engines as large as 150 h. p. Many of the complicated parts, such as were used in oiling and cooling the bearings, have been simplified, and the engine as now turned out has a more business-like look than the fancy motor first exhibited in this country about two years ago. It is necessary, of course, to make the engine of relatively great weight, due to the very high compression under which it works.

PERSONAL.

(For other personal mention see Elections and Appointments.)

—Mr. H. T. Sandford, Treasurer of the Cleveland, Lorain & Wheeling, died suddenly of pneumonia Jan. 1.

—Mr. U. B. Rogers, Auditor of the Chicago & West Michigan at Grand Rapids, Mich., committed suicide Dec. 30.

—Mr. A. V. Hartwell, who recently resigned as General Purchasing Agent of the Chicago & Alton, on January 1st assumed the active duties of President of the F. G. Hartwell Company, dealers in coal.

—Mr. William H. Penn, Chief Clerk of the Railway Mail Service at Des Moines, Ia., has been promoted to be Assistant Superintendent of the Sixth Division of that service to succeed Mr. E. L. West, whose promotion to be Superintendent of the Sixth Division was noted in our issue of Dec. 1. Mr. Penn has been in the Railway Mail Service for 27 years.

—Capt. J. J. Vandergrift, a well-known oil operator of Pittsburgh, Pa., died suddenly Dec. 26. He was a Director of the Pittsburgh Trust Company; Vice-President and Director of the Apollo Iron & Steel Company; President of the Vandergrift Electric Light Company; also President of the Vandergrift Fuel & Gas Company, and a Director of the National Tube Company.

—Mr. J. O. Bradeen, the new Division Master Mechanic of the Lake Shore & Michigan Southern at Elkhart, Ind., was born at North Waterboro, Me., Feb. 26, 1858. He entered the Buffalo shops of the Lake Shore Company in January, 1875, serving two years as apprentice, machinist and gang foreman. He was successively fireman, engineman, traveling engineer and roundhouse foreman, and in 1893 became Master Mechanic at Norwalk, O.

—Mr. Geo. A. Walker, the new Assistant to the Treasurer of the Pennsylvania Railroad, was born in Philadelphia, September 16, 1885. On November 19, 1880, he became an office boy in the Treasury Department of the Norfolk & Western Co., and later stenographer to the Treasurer. On July 18, 1887, he went to the Pennsylvania Railroad with Mr. Robt. W. Smith, who had been elected Treasurer of that company. On April 26, 1889, he was appointed by the Board of Directors as Acting Assistant to the Treasurer.